

THE GRAMINACEOUS RUSTS AND SMUTS  
OF KANSAS

by

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## INTRODUCTION

The prairie grasses and forbs have numerous parasitic fungi which are relatively unexplored today. This study can be considered a starting point to a more complete understanding of the Uredinales and Ustilaginales in Kansas, due to the fact that the pertinent literature has been condensed to the point where identification, reference, and study has been simplified.

This statewide treatment of the rust and smut fungi has been very interesting to prepare. The host specificity of some species and the broad ranges of others offers many thoughts upon which to ponder. There certainly could not be a better group of fungi to study in Kansas due to the "richness" of the mycological flora in rusts and smuts.

Gates (1937) listed 85 genera (25 cultivated) and 235 species (41 cultivated) of grasses in Kansas. At present there are 8 genera and 80 species (seven unsubstantiated) of rusts and smuts recorded as parasites of these grasses in Kansas. Many of these fungi were first collected and described in Kansas by such men as Kellerman, Swingle, Bartholomew, Ellis, Everhart, and others. Bartholomew (1927) in The Fungus Flora of Kansas stated that 20% (360 species) of his listings were first collected in Kansas. Perhaps this richness inspired these men and the zeal with which they studied should inspire mycologists of today.

This study of Kansas rusts and smuts could not have been completed without the assistance of Dr. Clark T. Rogerson, presently at the New York Botanical Garden. Dr. Rogerson compiled a list of fungi reported in the literature from Kansas, cataloged the herbarium specimens, verified many specimens at the New York Botanical Garden Cryptogamic Herbarium and added many collections to the Kansas State University Mycological Herbarium. His contributions have greatly helped our understanding of Kansas fungi.

A host genus index and illustrated key to the rust fungi is presented for the first time in this treatment. Additional copies have been prepared and sent to various mycologists for comments and criticisms. This key and the others in this treatment have been broadened to take in species that could occur in Kansas, thus making this manuscript desirable for reference in much of the great plains.

#### REVIEW OF LITERATURE

The review of Kansas literature pertaining to rusts and smuts in Kansas will be limited to papers referring to actual collections, and will exclude references to other literature reports. There have been many references in the literature by Clinton (1902, 1906), Weiss (1960), Zundel (1953) and others to Kansas rusts and smuts, but these were apparently based upon literature references and not actual collections. Some of the principal collectors of rusts and smuts in Kansas are: Kellerman, Swingle, J. B. S. Norton, Carleton,

Bartholomew, Hitchcock, Clothier, Lefebvre, Hansing, Johnston, Rogerson, Pady, and Kramer.

The first substantiated collections of graminaceous rusts and smuts in Kansas were done by Kellerman (1885). Cragin (1885) also listed several graminaceous species but unfortunately his specimens were destroyed. Kellerman and Carleton (1886) listed only three smut species and two rust species as occurring in Kansas on grasses.

In 1899 Bartholomew published the first extensive treatment of the rusts, Kansas Uredineae, which included many new state records. Bartholomew continued his intensive collecting and in 1927 published a list, The Fungus Flora of Kansas which also included many new state records. Although Bartholomew collected other fungi he did have a special interest in the rust fungi, which led to the publication of his most extensive work, the North American Uredinales (1928, revised in 1933). Many species of fungi which were collected by Bartholomew and other early workers have not been collected since, and were obviously found only as a result of a concentrated effort.

In 1932 Lefebvre and Johnston initiated Kansas Mycological Notes which is continued to date as Kansas Phytopathological Notes. In this series there are many reports of rusts and smuts from Kansas. Rogerson (1950-1957) began making a review of the literature and compiled a list that included all known collections and literature references to Kansas fungi. These lists (unpublished) have greatly aided

in studying the Kansas rusts and smuts.

#### PROCEDURE

The procedure used here was to examine all material available of each rust and smut species reported in Kansas. I verified all of the rust and smut specimens in the KSU mycological herbarium, in addition many field collections were made and identified. Certain smut specimens at the New York Botanical Garden were verified by C. T. Rogerson. In order to locate collections at the KSU herbarium Dr. Rogerson's unpublished check lists of the fungi of Kansas were used.

Free hand sectioning was done where necessary. In most cases the spores of both rusts and smuts were mounted in a buffered Shears Mounting Medium (Graham, 1960) which eliminates the chances for error due to varied reactions to a mounting medium.

Best results for viewing paraphyses in uredia were obtained by preparing free hand sections. Semipermanent slides of sections as well as spores were mounted in a mounting medium containing a stain since the spores and host tissue become too dense. However, it was occasionally necessary to stain some hyaline urediospores with 1% phloxine.

Pedicel length was most easily observed by teasing out masses of teliospores with a needle and heating in a drop of mounting medium on a slide. A plastic coverslip was then placed over the slide and the clumps of teliospores manipulated while the slide was still hot. This placed the

teliospores and pedicels all in the same plane and the pressure of the moulded coverslip held them in place while cooling. The actual point of pedicel attachment could then easily be observed.

Host identification was taken as that which appeared on the packet, unless some striking error was discovered. Host voucher specimens for most collections made by the author have been submitted to the Kansas State University herbarium. From 1961-1963 collections of rusts and smuts were made over the state of Kansas by the author. Approximately 1,000 collections of fungi was made. This included many nongraminaceous species.

Photomicrographic work was done using an A. J. Spencer Microstar Series 4, a 35 mm. film holder, and Adox KB-14 black and white film. All processing was done by the author. Photographs taken under low power of the microscope were enlarged using an Omega enlarger to 94X on the plates; those on high power 403X; and oil immersion 935X. The photographs in the illustrated section of the rust key were enlarged 275X. Macrophotographs were all taken with an Exakta camera on a copy stand using 4-100 watt incandescent lamps controlled with a rheostat and with substage lighting. The magnification for these pictures is either 2X or 4X (approximately) as indicated.

#### TAXONOMIC TREATMENT

The classification of Fisher (1953) was followed for the smut fungi while Cummins (1961) and Arthur and Cummins (1962) was used for the rust fungi. The nomenclature of the hosts



were changed to follow Hitchcock and Chase (1950).

The keys have been extended to include genera and species not found in Kansas, but that might be expected to occur here because of reports of them from neighboring states and because of the occurrence of the host plant in Kansas. Hopefully, this will extend the usability of these keys as more is understood about these fungi of Kansas.

This has been divided into two parts: the graminaceous smut fungi and the graminaceous rust fungi in Kansas. The letters following collections in the lists of specimens indicate that collections have been deposited at the New York Botanical Garden Cryptogamic Herbarium. Certain nongraminaceous rusts and smuts are treated here strictly for convenience. This would aid in the preparation of a forthcoming paper which will include all of the rusts and smuts.

#### Part I. THE GRAMINACEOUS SMUT FUNGI OF KANSAS

When using this treatment to identify Kansas smut fungi, the specimen in question may be identified first to genus in the following key to genera and then to species under the treatment of the genus. If the host is known it may be keyed directly in the host genus index and key to graminaceous smut fungi of Kansas.

#### Key to Genera of Graminaceous Smut Fungi of Kansas

(Based on Clinton, 1904)

1. Spores single (Sphacelotheca spores may appear to be clumped due to agglutination of spores around sterile cells) . . . . . 2
1. Spores in balls . . . . . 6
  2. Spores with a pedicel-like appendage . . . . . Neovossia
  2. Spores lacking a pedicel-like appendage . . . . . 3
3. Spores large, 16-36 u in diameter, usually in ovaries . . . . . Entyloma
3. Spores smaller, 4-18 u in diameter, in various parts of the host . . . . . 4
  4. Sorus covered with a peridium of fungus cells (this may break down into groups of sterile cells) . . . . . Sphacelotheca
  4. Sorus covered with peridium of host cells or if naked, sterile cells absent . . . . . Ustilago
5. Spore balls permanent . . . . . 7
5. Spore balls evanescent . . . . . Sorosporium
  6. Spore balls with a cortex of sterile cells . . . . . Urocystis
  6. Spore balls without cortex of sterile cells . . . . . Polysporiella

# Host Genus Index and Key to the Gramineaceous Smut Fungi of Kansas

The following key has been adapted from Fisher (1953) and the host genera are listed alphabetically. The species with solid underlining are those which have been reported from Kansas on the particular host in question but, in the opinion of the author, might possibly occur in the state. These are for the most part species with host genera that occur in Kansas and that have been reported on those hosts from surrounding areas.

Agropyron

1. Sori in the culms . . . . . 2
1. Sori in other parts of the host . . . . . 3
  2. Spores yellowish brown, very minutely echinulate  
(oil immersion) . . . . . Ustilago spetzazzinii
  2. Spores light olivaceous to olivaceous brown,  
smooth . . . . . Ustilago spetzazzinii var. agrestis
3. Sori in the inflorescence . . . . . 4
3. Sori mostly in vegetative parts of the host as short  
to long striae . . . . . 7
  4. Spores uniformly pigmented . . . . . 5
  4. Spores lighter on one side . . . . . 6
5. Spores echinulate to verrucose . . . . . Ustilago bullata
5. Spores reticulate . . . . . Tilletia caries
6. Spores smooth . . . . . Ustilago hordei
6. Spores minutely echinulate . . . . . Ustilago nuda
7. Spores in balls of 1-4, with a cortex of sterile  
cells . . . . . Urocystis agropyri
7. Spores free . . . . . 8
  8. Spores 14-19 u in diameter, prominently  
verrucose . . . . . Ustilago macrospora
  8. Spores 9-14 u in diameter, prominently  
echinulate . . . . . Ustilago striiformis

Agrostis

1. Sori as leaden to greenish black spots in the leaves,  
long covered by epidermis . . . . . Entyloma dactylidis
1. Sori as short to long striae in leaves, sheaths, etc.,  
soon erumpent . . . . . 2

2. Spores in balls of 1-4, with cortex of sterile cells . . . . . Urocystis agropyri

2. Spores free . . . . . Ustilago striiformis

Alopecurus . . . . . Entyloma dactylidis

### Andropogon

1. Sori as coalesced elongate masses on inner surface of leaf sheaths . . . . . Tolyposporella brunckii

1. Sori in the inflorescence or ovaries . . . . . 2

2. Spores in balls (rather evanescent in Sorosporium provinciale) . . . . . 3

2. Spores free (may be clumped around sterile cells) . . . . . 5

3. Spores 7-11 u in diameter . . . Sorosporium everhartii

3. Spores 12-20 u in diameter . . . . . 4

4. Exospore about 1 u thick . . Sorosporium ellisii

4. Exospore 3-4 u thick . . Sorosporium provinciale

5. Sori in ovaries . . . . . 6

5. Sori more or less consuming the entire inflorescence . . . Sphacelotheca andropogonis

6. Spores 7-12 u . . . . . Sphacelotheca seymouriana

6. Spores 13-18 u . . . . . Sphacelotheca occidentalis

Aristida . . . . . Sorosporium consanguineum

Arrhenatherum . . . . . Ustilago avenae

### Avena

1. Spores perfectly smooth . . . . . Ustilago hordei

1. Spores minutely echinulate . . . . . Ustilago avenae

Beckmannia . . . . . Ustilago striiformis

Bouteloua

1. Sori in the inflorescence . . . . . Ustilago neglecta
1. Sori as conspicuous blister-like lesions on leaves. .2
2. Spores 7-11 u in diameter . . . . . Ustilago minor
2. Spores 10-16 u in diameter . . . Ustilago buchloes

Bromus

1. Sori as short to long striae in the leaves and sheaths, sometimes involving the inflorescence . .2
1. Sori in ovaries or spikelets . . . . . . . . . . .4
2. Spores in balls of 1-4, with cortex of sterile cells . . . . . Urocystis agropyri
2. Spores free .3
3. Spores 9-14 u in diameter, prominently echinulate . . . . . Ustilago striiformis
3. Spores 14-19 u in diameter, prominently verrucose . . . . . Ustilago macrospora
4. Spores reticulate . . . . . . . . . . . Tilletia caries
4. Spores echinulate to verrucose . . . . . . . . . . .5
5. Spores 6-11 u in diameter . . . . . Ustilago bullata
5. Spores 10-17 u in diameter .  
. . . Ustilago bullata var. macrospora

Buchloe<sup>n</sup>

1. Sori as blister-like or sausage-shaped pustules on " leaves and sheaths . . . . . Ustilago buchloes
1. Sori in ovaries and spikelets . . . . . . . . . . .2
2. Spores tuberculate . . . . . Tilletia buchloeana
2. Spores echinulate . . . . . . . . . . Ustilago neglecta

Calamagrostis

1. Spores in balls of 1-4, with cortex of sterile cells . . . . . Urocystis agropyri

1. Spores free . . . . . Ustilago striiformis

Cenchrus . . . . . Sorosporium cenchri

Cynodon . . . . . Ustilago cynodontis

Dactylis

1. Spores in balls with a cortex of sterile cells . . . . . Urocystis agropyri

1. Spores free . . . . . Ustilago striiformis

Danthonia . . . . . Ustilago striiformis

Digitaria

1. Sori in ovaries . . . . . Tilletia pulcherrima

1. Sori involving entire inflorescence . . . . . Ustilago syntherismae

Echinochloa

1. Sori as conspicuous, globose galls chiefly on vegetative parts but occasionally in the inflorescence; spores 9.5-13 u in diameter . . . . . Ustilago crusgalli

1. Sori in the ovaries only; spores 6.5-11 u . . . . . Ustilago sphaerogena

Elymus

1. Sori on the internodes . . . . . 2

1. Sori elsewhere . . . . . 3

2. Spores yellowish brown, very minutely echinulate (oil immersion) . . . . . Ustilago spessazzinii

2. Spores light olivaceous to olivaceous brown, smooth . . . Ustilago spessazzinii var. agrestis

3. Sori as striae in leaves and sheaths sometimes  
in the inflorescence . . . . . 4
3. Sori in the ovaries and spikelets . . . . . 6
4. Spores in balls with a cortex of sterile  
cells . . . . . Urocystis agropyri
4. Spores free . . . . . 5
5. Spores 9-14 u in diameter, prominently echinulate .  
. . . . . Ustilago striiformis
5. Spores 14-19 u in diameter, prominently verrucose .  
. . . . . Ustilago macrospora
6. Spores smooth, 5-8 u in diameter . Ustilago hordei
6. Spores granular-verrucose, 8-12 u in diameter .  
. . . . . Ustilago bullata

Eragrostis . . . . . Ustilago spermophora

Euchlaena . . . . . Ustilago maydis

#### Festuca

1. Sori as striae, principally in the leaves and  
sheaths . . . . . 2
1. Sori in all or parts of the inflorescence, not as  
striae . . . . . 3
2. Spores in balls of 1-4, with distinct cortex of  
sterile cells . . . . . Urocystis agropyri
2. Spores free . . . . . Ustilago striiformis
3. Spores granular-verrucose to verrucose . . . . .  
. . . . . Ustilago bullata
3. Spores reticulate or coarsely tuberculate . . . . . 4
4. Spores with coarse conical spines, embedded in a  
hyaline gelatinous sheath, 2-3.5 u thick . . .  
. . . . . Tilletia texana
4. Spores reticulate, devoid of sheath . . . . . 5

5. Spores 14-23 u in diameter . . . . . Tilletia caries

5. Spores 21-27 u in diameter . . . . . Tilletia fusca

### Glyceria

1. Sori as striae, chiefly in the leaves and sheaths .  
 . . . Urocystis agropyri

1. Sori in spots in the leaves and sheaths, long covered  
 by the epidermis . . . . . 2

2. Spores 7-11 x 8-17 u, deeply colored . . . . .  
 . . . Entyloma dactylidis

2. Spores 13-23 x 16-29 u, pale . Entyloma spragueanum

Hilaria . . . . . Ustilago vilfae

### Holcus

1. Sori as striae, spores echinulate . . . . .  
 . . . Ustilago striiformis

1. Sori as leaden to greenish black spots, spores  
 smooth . . . . . Entyloma dactylidis

### Hordeum

1. Sori surrounding the internodes . . . . .  
 . . . Ustilago spengazzinii var. agrestis

1. Sori elsewhere . . . . . 2

2. Sori in all or parts of the inflorescence,  
 rarely in the flag leaf . . . . . 3

2. Sori primarily in the leaves and sheaths,  
 occasionally including the inflorescence . . . 4

3. Spores in balls of 1-4 spores, with distinct cortex  
 of sterile cells . . . . . Urocystis agropyri

3. Spores free . . . . . Ustilago striiformis

4. Spores 5-8 u in diameter, lighter colored on one  
 side . . . . . 6



4. Spores more than 8  $\mu$  in diameter . . . . . 8
5. Spores perfectly smooth . . . . . Ustilago hordei
5. Spores minutely echinulate . . . . . Ustilago bullata
6. Germination indirect (i.e., with promycelium  
and sporidia) . . . . . Ustilago avenae
6. Germination direct (i.e., with branching germ  
tube and no sporidia). . . . . Ustilago nuda

Hystrix . . . . . Ustilago striiformis

#### Koeleria

1. Spores in balls of 1-4, with distinct cortex of  
sterile cells . . . . . Urocystis scrobyri
1. Spores single . . . . . Ustilago striiformis

#### Leptochloa

1. Sori in leaden to greenish black spots in the  
leaves; spores smooth . . . . . Entyloma dactylidis
1. Sori otherwise; spores echinulate. Ustilago heterogena

#### Leptoloma

1. Spores in balls; sori in the inflorescence . . . . .  
. . . . . Sorosporium cenchri
1. Spores free or adhering in small, irregular groups;  
sori in spots in the leaves . . . Entyloma dactylidis

#### Lolium

1. Sori as striae in the leaves . . Ustilago striiformis
1. Sori in the spikelets or entire inflorescence . . .  
. . . . . Ustilago nuda

#### Melica

1. Sori as striae in the leaves and sheaths . . . . . 2
1. Sori surrounding the internodes . . . . . 3

2. Spores in balls of 1-4 spores, with definite cortex of sterile cells. . . . Urocystis agropyri
2. Spores free . . . . . Ustilago striiformis
3. Spores light yellowish brown, minutely echinulate, especially at the opposite poles . . . . . Ustilago spengazzinii
3. Spores darker, smooth, or at most somewhat lacerated at opposite poles . . . . . 4
4. Spores bipolar: with either entire apical caps or lacerated crests at the poles (oil immersion) . . Ustilago spengazzinii var. agrestis
4. Spores not at all bipolar . . . Ustilago hypodytes

#### Muhlenbergia

1. Sori in leaden to greenish black spots, long covered by the epidermis . . . . . Entyloma dactylidis
1. Sori in conspicuous erumpent pustules or striae . . 2
2. Spores 7-11 u in diameter . . . . Ustilago minor
2. Spores 10-18 u in diameter . . . . Ustilago buchloë

#### Oryzopsis

1. Spores (at least some) with bipolar caps or lacerations (oil immersion) . . . . . Ustilago spengazzinii var. agrestis
1. Spores not bipolar . . . . . Ustilago hypodytes

#### Panicum

1. Sori in the leaves and sheaths (as striae or spots) . . . . . Entyloma dactylidis
1. Sori usually in all or parts of the inflorescence .  
(Ustilago heterogena sometimes forms galls on stems or leaves . . . . . 2

2. Spores in balls (may be evanescent) . . . . . Sorosporium cenchri
2. Spores free . . . . . 3
3. Spores over 18 u in diameter . . . . . 4
3. Spores under 15 u in diameter . . . . . 5
4. Spores finely verrucose; pale yellowish to clear reddish brown, naked . . . . Tilletia maclaganii
4. Spores coarsely verrucose to cerebriform, opaque dark reddish brown, invested in a thin, tinted sheath . . . . . Tilletia pulcherrima
5. Spores smooth to finely punctate, 7-10 u in diameter . . . . . Sphacelotheca destruens
5. Spores echinulate, 9-14 u in diameter . . . . . Ustilago heterogena

### Phalaris

1. Sori surrounding the internodes . . . . . Ustilago spegazzinii var. agrestis
1. Sori as striae in leaves and sheaths . . . . . 2
2. Spores 9-14 u in diameter . . Ustilago striiformis
2. Spores 14-19 u in diameter . Ustilago macrospora

### Phleum

1. Sori surrounding the internodes . . . . . Ustilago spegazzinii var. agrestis
1. Sori in the leaves and sheaths . . . . . 2
2. Sori in leaden to greenish black spots . . . . . Entyloma dactylidis
2. Sori in striae in leaves and sheaths . . . . . 3
3. Spores in balls of 1-4 spores, with a distinct cortex of sterile cells . . . . . Urocystis agropyri
3. Spores free . . . . . Ustilago striiformis

Phragmites . . . . . Neovossia lowensis

Poa

1. Sori surrounding the internodes . . . . . 2
1. Sori elsewhere . . . . . 3
  2. Spores light yellow to golden brown, minutely echinulate, especially at opposite poles . . . . . Ustilago spetzazzinii
  2. Spores darker, smooth but sometimes lacerated at opposite poles . . . . . Ustilago spetzazzinii var. acrestis
3. Sori in the leaves or sheaths . . . . . 4
3. Sori in the ovaries . . . . . Tilletia fusca
  4. Sori as circular to elliptical spots . . . . . 5
  4. Sori as striae, or confluent . . . . . 6
5. Spores 7-11 x 8-17 u . . . . . Entyloma dactylidis
5. Spores 13-23 x 16-29 u . . . . . Entyloma soraguanum
6. Spores in balls of 1-4 spores, with distinct cortex of sterile cells . . . . . Urocystis acropyri
6. Spores free . . . . . Ustilago striiformis

Puccinellia

1. Sori surrounding the internodes . . . . . 2
1. Sori in the leaves and sheaths . Ustilago striiformis
  2. Spores absolutely smooth (oil immersion) . . . . . Ustilago hypodytes
  2. Spores minutely echinulate more strongly at the poles, or smooth but with bipolar caps or minute lacerations at the poles . . . . . 3
3. Spores yellowish brown, very minutely echinulate . . . . . Ustilago spetzazzinii

3. Spores light oliveaceous to oliveaceous brown, smooth,  
but with bipolar caps or minute lacerations . . .  
. . . Ustilago sparganii var. agrestis

Redfieldia . . . . . Tilletia redfieldiae

### Secale

1. Spores in balls of 1-4 with incomplete cortex of  
sterile cells . . . . . Urocystis occulta
1. Spores free . . . . . 2
2. Sori surrounding the internodes . . . . .  
. . . Ustilago sparganii var. agrestis
2. Sori in all or parts of the inflorescence . . . 3
3. Spores 15-25 u in diameter . . . . . 4
3. Spores smaller (not over 10 u in diameter) . . . 5
4. Spores reticulate . . . . . Tilletia caries
4. Spores smooth . . . . . Tilletia foetida
5. Spores echinulate . . . . . Ustilago nuda
5. Spores smooth . . . . . Ustilago hordei

### Setaria

1. Spores smooth . . . . . Ustilago crameri
1. Spores more or less echinulate . . . Ustilago neglecta

### Sitanion

1. Sori in the spikelets . . . . . Ustilago bullata
1. Sori in the culms or leaves and sheaths (sometimes  
including the aborted inflorescence) . . . . . 2
2. Sori surrounding the internodes . . . . . 3
2. Sori in the leaves, sheaths, and sometimes  
including the aborted inflorescence . . . . . 4



Stipa

1. Spores in balls of 1 to many, with distinct cortex of sterile cells . . . . . 2
1. Spores free . . . . . 3
  2. Sori in the spikelets; spore balls 20-40 u in diameter . . . . . Urocystis granulosa
  2. Sori confluent on the contorted culms and aborted inflorescence; spore balls 35-70 u in diameter . . . . . Urocystis fraseri
3. Spores perfectly smooth, with uniform exospore . . . . . Ustilago hypodytes
3. Spores echinulate-verrucose or with bipolar appendages or minute caps on the exospore . . . . . 4
  4. Spores clear yellowish brown or light olivaceous; exospore minutely echinulate usually more evident at bipolar areas as crests of echinulations . . . . . Ustilago spagazzinii
  4. Spores light olivaceous to olivaceous brown; exospore smooth with bipolar areas varying from entire apical thickenings to more or less lacerated crests . . . . . Ustilago spagazzinii var. agrestis

Trisetum

1. Spores in balls of 1-4, with distinct cortex of sterile cells . . . . . Urocystis agropyri
1. Spores free . . . . . Ustilago striiformis

Triticum

1. Spores in balls of 1-4 with distinct cortex of sterile cells . . . . . Urocystis agropyri
1. Spores free . . . . . 2
  2. Spores 5-8 u in diameter . . . . . Ustilago nuda
  2. Spores 15-23 u in diameter . . . . . 3

3. Spores smooth . . . . . Tilletia foetida  
 3. Spores reticulate . . . . . Tilletia caries

### Zea

1. Sori in the inflorescence only, with several long, prominent columellae or sometimes a single central columella . . . . . Sphacelotheca reiliana  
 1. Sori in various parts of the host, arising from localized infections, large and gall-like, columella absent . . . . . Ustilago maydis

### SOROSPORIUM Rudolphi

Linnaea 4:116. 1829.

TYPE SPECIES: Sorosporium saponariae Rud.

Sori in various parts of the host, most frequently in the reproductive parts, often with a peridium, usually brown to black and powdery at maturity; spore balls globose to ovoid with no sterile cell balls sometimes very fragile at maturity and generally disintegrate into individual spores or groups of spores; germination by means of one or more promycelium with lateral sporidia or directly by a branching germ tube without sporidia.

Because of its sometimes evanescent spore balls, Sorosporium can be easily mistaken for Ustilago or Sphacelotheca. If young sori are examined spore balls are more likely to be found. Sphacelotheca occidentalis can quite easily be mistaken for Sorosporium because of the presence of sterile cells with spores agglutinated around them. These structures resemble spore balls and can be easily mistaken. Polyhedral spores should be viewed



with suspicion because these are not common in Sorosporium. Amorphous groups of spores in Ustilago can also be misleading. Sorosporium could be confused with Thecaphora and Tolyanorella but these genera have permanent spore balls.

Three graminaceous species, Sorosporium cosanguineum, S. cenchri and S. provinciale are represented in the Kansas State University Mycological Herbarium. Sorosporium ellisi and S. everhartii are listed in the Kansas literature but there are no specimens on record to substantiate those collections. These two species will be included on the list but will be treated as non-represented species.\*

#### Key to Species

1. Sori principally or entirely confined to ovaries . . . . . 2
1. Sori more or less destroying entire inflorescence or floral structures . . . . . 3
  2. Spore balls 35-70 x 50-120 u in diameter; on Aristida. Spores 6-8.5 u, smooth to very faintly echinulate; not on Aristida. . . . . S. consanguineum
  2. Spore balls 45-150 x 75-180 u; spores tend to be polyhedral . . . . . S. everhartii
3. Spores mostly under 13 u (9-13 u), minutely echinulate . . . . . S. cenchri
3. Spores mostly over 13 u . . . . . 4
  4. Spores 12-20 u, wall thick 3-4 u . . . . . S. provinciale
  4. Spores 12-18 u, wall thin 1 u . . . . . S. ellisi

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\* See discussion under each species

1. Sorosporium cenchri Henn., Hedwigia 35:221. 1896.

Syn: Sorosporium syntherismae (Peck) Farl. In Farl. and Seym., Host Index N. Am. Fungi p. 152 1891.

Sorus consumes entire inflorescence and leaves only shredded remains of vascular bundles, yellowish peridium ruptures irregularly and exposes dark brown, dusty spore masses; spore balls more or less evanescent globose to oblong, dark brown 35-70 x 70-105 u; spores globose, subglobose to elongate, olive brown abundantly and minutely echinulate, 9-15 u in diameter.

In 1961 this fungus was found by the author to be quite abundant in the western portion of Kansas, but in 1962 it was relatively rare.

SPECIMENS EXAMINED:

on Cenchrus pauciflorus Benth.: Barton Co.: 10 mi W of Great Bend, Haard (2) and Kramer, Oct. 10, 1961. Finney Co.: 10 mi W of Garden City, Haard (1) and Kramer, Oct. 10, 1961. Marion Co.: N of Lincolnville, Rogerson, Oct. 18, 1955. Ottawa Co.: Rock City, SW of Minneapolis, Rogerson, Nov. 1, 1957. Pottawatomie Co.: NW of St. George, Rogerson, Aug. 1956; 1 mi NW of Fostoria, Rogerson, Oct. 18, 1957. Riley Co.: Zeandale, Rogerson, Oct. 21, 1955; Ashland Agronomy Farm, Rogerson, Jul. 26, 1955. Wallace Co.: Wallace, Parker, as Ustilago syntherismae (SchW.) Peck., Sept. 16, 1924. Wichita Co.: County State Park, Rogerson, (2 Packets), Nov. 1, 1957.

on Cenchrus tribuloides L.: Harvey Co.: Burton, Saltzman,  
as Ustilago cesatii Fish. de Waldn., Oct. 21, 1895. Kingman Co.:  
Kingman as U. cesatii, Oct. 26, 1889. Republic City, Norton,  
as U. cesatii, Aug. 20, 1895. Riley Co.: Manhattan, Thompson  
(95), as U. cesatii, Aug. 20, 1891. Rooks Co.: Bartholomew  
(USDA Mycological Exch. 16), as Sorosporium syntherismae,  
Sept. 10, 1917.

on Cenchrus spp.: Riley Co.: Burton and Brooks, as  
Ustilago syntherismae Peck, Oct. 13, 1938.

on Panicum dicotemoflorum Michx.: Lyon Co.: Emporia,  
Bartholomew (Sydow Ustilagineen 348), as S. syntherismae on  
Panicum proliferum. Miami Co.: County State Park, muddy  
margin of lake, McGregor and Kramer (1345), (3 packets),  
Sept. 18, 1955.

on Panicum capillare L.: Lyon Co.: Emporia, Bartholomew  
(USDA Mycol. Exch. 1921, 19) as S. syntherismae, Oct. 26, 1903.  
Rooks Co.: Bartholomew (Ell. and Ev. Fung. Columb. 1785)  
as U. syntherismae, Jan. 10, 1896, (NY).

on Panicum spp.: Riley Co.: Manhattan, Kellerman and  
Swingle (2816), Sept. 12, 1887.

2. Sorosporium consanguineum Ell. and Ev., Jour. Myc. 3:56.  
1887. (Plate I, Fig. 3)

Similar macroscopically to Sorosporium confusum; spore balls  
measure 35-70 x 50-120 u subglobose to very irregular, yellowish

brown to reddish brown; spores subglobose to polyhedral, clear yellowish brown, 6-8.5 u in diameter, with smooth to faint echinulations on the exposed surfaces (outside surfaces of spore balls).

There are only a few collections of this fungus for Kansas. A special effort should be made to look for this species when collecting.

SPECIMENS EXAMINED:

on Aristida (?purpurea Nutt.): Ellis Co.: Hitchcock, as Ustilago aristidae Peck, July 10, 1895; Hitchcock Leg Bartholomew (34) July 16, 1895. Hodgman Co.: Hitchcock, as U. aristidae, Aug. 1895.

on Aristida longiseta Steud.: No location, W. H. Horr, Aug. 1952.

on Aristida Sp.: Sheridan Co.: Lefebvre, 1931.

3. Sorosporium ellisii Wint., Hedw. 22:2. 1883.

Sorus involving the entire inflorescence or more rarely confined to individual spikelets, elongate, chiefly 1-5 cm. in length, often hidden by enveloping leaf sheaths, provided with a conspicuous peridium which soon ruptures to release the dark brown, dusty spore mass; spore balls are mostly globose to subglobose, some rather cylindric, opaque, dark brown, 30-80 u in diameter; spores globose to subglobose or often polyhedral, yellowish brown to deep olive brown, rather opaque, 12-18 u in diameter with wall about 1 u thick, very

minutely verrucose to almost smooth on the inner spores of spore balls but more conspicuously verrucose on the outer spores.

There were no specimens in the K.S.U. herbarium to be examined but this species has been cited in the literature as occurring in Kansas. Clinton (1902) first gave reference to S. ellisii on Andropogon scoparius Michx. in Kansas but listed no collection. Jackson (1908) discusses S. ellisii but gives no reference to examining material from Kansas but listed Kansas as within its range. Zundel (1930) listed S. ellisii as occurring in Kansas but again, did not refer to any collections. Lefebvre and Johnston (1936) made the first specific report of S. ellisii on big and little bluestem from many localities in the eastern half of Kansas. However, this citation also did not refer to any specimens. This species will then remain on the list of Kansas fungi as unsubstantiated.

4. Sorosporium everhartii Ell. and Gall., Jour. Myc. 6:32. 1890.

Sori in ovaries, linear, about 1-2 cm in length, with a prominent peridium dehiscing from the apex in several lobes to expose the dark brown, more or less indurate spore mass, which after weathering away exposes the flattened columella of plant tissue; spore balls globose, subglobose to cylindric and irregular, dark chestnut brown, rather firm, 45-150 x 75-180 u; spores mostly polyhedral, some globose to subglobose, those on interior of the spore ball yellowish brown, thin walled, and

smooth to papillose, those on the exterior thicker walled (about 1-5 u) and minutely verrucose, especially on the free surface, chestnut brown, 7-11 u in diameter.

There are no specimens from Kansas in the K.S.U. herbarium. Johnston, et al (1939) reported S. everhartii on Andropogon gerardi Vitm. (as A. furcatus Muhl.), on a selection in the grass nursery that showed variability to rust susceptibility. Hansing and Lefebvre (1941) reported S. everhartii on Andropogon gerardi Vitm. (A. furcatus) but no specimens are in the herbarium of either of these reports. This species will remain on the list of Kansas fungi as unsubstantiated.

5. Sorosporium provinciale (Ell. and Gall.) Clint., Jour. Myc. 8:145. 1902. (Plate I, Fig. 4)

Syn: Sorosporium ellisii Wint. var. provincialis Ell. and Gall. Jour. Myc. 6:31. 1890.

Sorus in aborted inflorescence, covered at first by peridium which later exposes a blackish spore mass with shredded remains of host tissue; spore balls globose to subglobose, rather evanescent, clear yellowish brown, 40-90 u in diameter; spores clear yellowish brown, quite regularly globose 12-20 u in diameter, very thick walled and minutely verrucose.

It is interesting to note that this fungus was collected by Rogerson on Andropogon hallii Hack. The native range of this grass is the western sector of Kansas, where S. provinciale had never been collected on this host, but when this host was moved to the Ashland Agronomy farm in Manhattan in the eastern half of the state where this fungus occurs on A. gerardi, it

Plate I

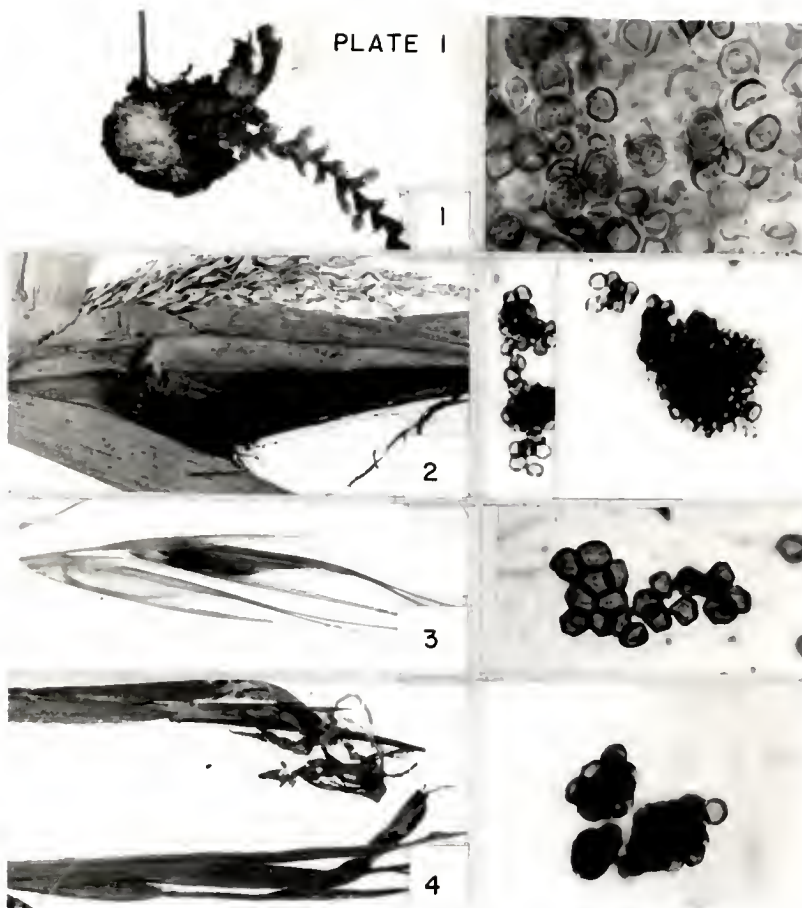
Fig. 1 Melanopsichum pennsylvanicum. (Non graminaceous)  
on Polygonum persicariae 2 X; spores 935 X.

Fig. 2 Sorosporium cenchri.  
on Panicum dicotomoflorum 2 X; spores 403 X.

Fig. 3 Sorosporium cosanguineum.  
on Aristida (purpurea)? 4 X; spores 935 X.

Fig. 4 Sorosporium provinciale.  
on Andropogon (hallii) 2 X; spores 403 X.

## PLATE I





appeared on the western A. hallii

SPECIMENS EXAMINED:

on Andropogon gerardi Vitm.: Riley Co.: Manhattan, KSC  
grass plots, Rogerson and Pickett, Aug., 1953. Rooks Co.:  
Bartholomew (USDA, BPI Mycol. Ex. 66711), as Ustilago  
syntherismae Peck Oct. 1897, (NY); Bartholomew, as U. syntherismae,  
Oct. 1894; Stockton, Bartholomew, Oct. 1897; Bartholomew as U.  
syntherismae, Oct. 1894; Stockton, Bartholomew (USDA Mycol.  
Exch. 1921) as Sorosporium syntherismae (Peck) Farl., Sept. 10,  
1917.

on Andropogon hallii Hack.: Riley Co.: Ashland Agronomy  
Farm, Rogerson, June 25, 1955; Ashland Agronomy Farm, Rogerson,  
June 15, 1955; Ashland Agronomy Farm (Row 53-1), Pickett and  
Rogerson, June 20, 1955, (NY).

SPHACELOTHECA de Bary

Verg. morph. Biol. Pilze p. 187. 1884.

Syn: Endothlapis Sorokin, Rev. Myc. 12:4. 1890.

TYPE SPECIES: Sphacelotheca hydropiperis (Thuem.)  
de Bary.

Sori in most of the host parts but more often in the  
ovaries or entire inflorescence, granular to powdery covered  
by peridium which separates into groups of sterile cells of  
various shapes; spores formed around a central columella of  
host tissue, germination indirect, with lateral sporidia.

The differentiation of Sphacelotheca from Ustilago is generally based upon the presence of a definite peridium of fungus tissue and the basipetal spore formation around a central columella of host tissue. Groups of sterile cells with spores aggregated around them can sometimes superficially resemble the spore balls of Sorosporium.

Sphacelotheca hydripiperis has not been reported for Kansas but should be expected, since the host, Polygonum sp., does range into the state.

#### Key to Species

1. Purplish spores, on Polygonaceae . . . . . S. hydripiperis
1. Brown to black spores, on Gramineae . . . . . 2
  2. Sori involving the entire inflorescence . . . . . 3
  2. Sori confined to ovaries only . . . . . 5
3. Spores mostly 10-12 u in diameter, abundant echinulations . . . . . S. reilliana
3. Spores mostly 7-9 u in diameter . . . . . 4
  4. Sterile cells generally adhere in subspherical groups 25-40 u in diameter; on Andropogon . S. andropogonis
  4. Sterile cells not adhering; on Panicum . . S. destruens
5. Spores 13-18 u in diameter, minutely and sparsely echinulate - verrucose . . . . . S. occidentalis
5. Spores smaller generally 5-12 u . . . . . 6
  6. Peridium fragile; spores 6.5-10 u in diameter; well developed columella . . . . . S. cruenta
  6. Peridium tough . . . . . 7
7. Spores smooth to minutely echinulate 7-12 u in diameter, light reddish brown . . . . . S. seymouriana

7. Spores minutely to primarily echinulate - verrucose, none smooth, 5-8.5 u in diameter; sterile cells in groups up to 7-18 u in diameter . . . . . S. sorghi

1. Sphacelotheca andropogonis (Opiz) Bubak, Die Pilze Bohmens II, Brandp. p. 25. 1916. (Plate II, Fig. 1).

Syn: Ustilago ischaemi Fekl., Jahrb. Ver. Nat. Nass. 15:22. 1861.

Ustilago cylindrica Peck, Bot. Gaz. 7:55. 1882.

Sphacelotheca ischaemi (Fekl.) Clint., Jour. Myc. 8:140. 1902.

Sphacelotheca ischaemi (Fekl.) Clint., f. heteropogonis Bacc., Ann. Bot. (France) 14:131. 1917.

Sphacelotheca andropogonis (Opiz) Koch., Fl. Polonica 4:75. 1936.

Sori in entire inflorescence, enclosed by enveloping leaves, peridium and central columella present, sterile cells from peridium present throughout the spore mass; spores subglobose to globose, occasionally somewhat polyhedral, light reddish brown, smooth or very faintly granular papillose, 7-10 u in diameter.

It is interesting to note that there have not been any collections of this fungus made since 1900. Although it has been reported in the literature on Andropogon hallii Hack., A. scoparius Michx. and A. gerardi Vitm. only collections on the latter host are in the K.S.U. herbarium.

#### SPECIMENS EXAMINED:

on Andropogon gerardi Vitm.: Pettawatomie Co.: St. George, A. S. Hitchcock (914), as Ustilago andropogonis Kell. and Swing. on Andropogon furcatus Muhl., May 25, 1896; St.

George, Hitchcock and Bartholomew (28), as Sphacelotheca ischaemi (Fekl.) Clint., May 25, 1896. Books Co.: Rockport, Bartholomew, Ustilago ischaemi Fekl. on Andropogon provincialis Lam., May 30, 1888, (NY); Rockport, Bartholomew as U. ischaemi on A. provincialis, June 3, 1888, (NY); Rockport, Bartholomew, as Ustilago cylindrica Peck on A. provincialis, June 3, 1888, (NY); Bartholomew (Fungi Columb. 1783), as S. ischaemi, June 6, 1898.

2. Sphacelotheca cruenta (Kuhn) Potter, Phytopath 2:98. 1912. (Plate II, Fig. 2).

Syn: Sphacelotheca holci Jacks., Monogr. Univ. Puerto Rico. Ser. B., No. 2:259. 1934.

Sori in ovaries, ovate, covered with a delicate peridium soon disintegrates exposing dark brown dusty spores; columella well developed and on some hosts very prominent; sterile cells ovoid, thin walled groups, hyaline, 9-19 u in length; spores globose to subglobose, light yellowish to oliveaceous brown, thin walled, 6.5-10 u in diameter, minutely echinulate.

This species is difficult to tell from Sphacelotheca sorghi (Link.) Clint. The spores in S. sorghi are smaller and are enclosed in a tougher peridium.

#### SPECIMENS EXAMINED:

on Sorghum halepense L.: Barber Co.: E of Medicine Lodge, Rogerson, June 21, 1956. Butler Co.: N of Latham, Rogerson, June 21, 1956. Clark Co.: W of Big Basin, Rogerson, June 21, 1956. Comanche Co.: S of Coldwater, Rogerson,

June 17, 1952. Finney Co.: Kearny-Finney Co. line, Haard (5) and Kramer, Oct. 9, 1961. Greenwood Co.: Rt. 99, Rogerson and Hansing, June 21, 1954, (NY). Kearny Co.: N of Lackin, Haard (6) and Kramer, Oct. 9, 1961. Iowa Co.: Belvidere, Rogerson and Mulbert, June 21, 1956. Meade Co.: NE of Plains, Rogerson, June 20, 1956. Mitchell Co.: edge of Glen Elder, Rogerson, June 18, 1956. Montgomery Co.: N of Dearing, Rogerson, June 11, 1957. Morton Co.: W of Leonia, Rogerson, June 18, 1956; along Cinnamon River Rt. 50, Rogerson, June 20, 1956. Riley Co.: N of Manhattan, Rogerson, June 18, 1955, (NY). Stanton Co.: Rogerson, June 20, 1956. Sumner Co.: Wellington, Rogerson, June 21, 1956.

on Sorghum sudanense (Piper) Stapf.: Riley Co.: KSC Agronomy Farm, Rogerson, Oct. 8, 1954.

on Sorghum vulgare Pers. var sudanense: Riley Co.: KSC Campus, Rogerson, June 19, 1956.

3. Sphacelotheca destruens (Schlecht.) Stev. and A. G. Johns., Phytopath. 34:613. 1944. (Plate II, Fig. 3).

Syn: Ustilago panici-milacei (Pers.) Wint. In Rabenh., Krypt. Fl. 1:89. 1884.

Sori in inflorescence, destroying it completely, leaving remains of vascular bundles of host, tough whitish peridium present at first, later rupturing exposing a dusty dark brown spore mass; spores globose to subglobose, light olive brown,

mostly smooth sometimes appearing lightly punctate under oil immersion, 7-10 u.

Only two collections have been examined from the state but it is possibly much more common than indicated.

on Panicum capillare L.: Franklin Co.: 1 mi E and 2 mi W Homewood, edge Ash Hickory woods, Kramer and McGregor (1220), May 14, 1955. Riley Co.: Manhattan K.S.C. Campus as Ustilago panicis-milacei (Pers.) Wint. Melchers and White, Oct. 22, 1915.

4. Sphacelotheca occidentalis (Seym.) Clint., Jour. Myc. 8:141. 1902. (Plate II, Fig. 4).

Syn: Sorosporium ellisii Wint. var occidentalis Seym. In Ell. and Ev. N. Am. Fungi, p. 2265. 1889.

Ustilago andropogonis Kellerm. and Sw., Jour. Myc. 5:12-13. 1889.

Sori in ovaries, linear, 0.5-1 cm or more in length, with prominent peridium dehiscing from apex, disclosing granular to dusty dark brown spore mass and prominent columella; sterile cells of peridium hyaline, variable in shape and size, adhering together rather firmly, sterile cells of the interior composed of more regular subglobose units; spores globose, subglobose to avoid or somewhat polyhedral, yellowish brown to chestnut brown, thin walled, 13-18 u (generally on the smaller side) in diameter, minute and sparsely echinulate-verrucose.

The spore measurements of our material all seemed to fall in the lower limits of measurement, 11-14 u; no spores were

observed in the upper, 15-18 u, limit. This smaller size of spores might indicate this to be Sphacelotheca seymouriana Clint. but this does not seem logical because of the geographic distribution of S. seymouriana. This problem definitely needs more study.

# SPECIMENS EXAMINED:

on Andropogon gerardi Vitm.: Butler Co.: 5 mi W of Latham, Rogerson, July 26, 1957; 14 mi W Keightberg, September 1957. Ellsworth Co.: Hitchcock, as Ustilago andropogonis Kellerm. and Sw, July 12, 1895; Hitchcock, as U. andropogonis July 11, 1895. Harper Co.: Kellerman and Swingle (Type, 1344), as U. andropogonis, July 14, 1888. Osborne Co.: Osborne, as U. andropogonis, July and August, 1894, (NY). Ottawa Co.: Hitchcock, as U. andropogonis, July 1, 1895. Riley Co.: 4 mi NW of Manhattan, Kramer (2604) and Duffield, Sept. 24, 1958; Hills E of Manhattan, Rogerson, as Andropogon furcatus Muhl. September 24, 1958; Manhattan, Bartholomew (Kansas Fungi Fascicle I) as A. furcatus, July 11, 1895; Manhattan, Slagg and Rogerson, as A. furcatus, Aug. 1944; NE of Randolph, Rogerson, July 16, 1959; Prairie 5 mi E of Junction K-13 and US 40, Kramer (2593) and Duffield, as Sphacelotheca seymouriana Clint., September 19, 1958; Manhattan, Thompson, July 27, 1892 (as U. andropogonis). Rocks Co.: Stockton, Bartholomew (Fungi Columb. 3388), as A. furcatus, June 30, 1910, (NY);

Bartholomew (USDA DPI Mycol. Ex. 66712), as A. furcatus, July 18, 1905, (NY). Rooks Co., hosts were identified as Andropogon provincialis Lam.: as U. andropogonis, July 22, 1895; Kellerman and Swingle (NY); Rockport, Bartholomew (Fungi Columb. 538), as U. andropogonis, July 1894, (NY); Bartholomew, as U. andropogonis, Aug. 7, 1894, (NY); Rockport, Bartholomew (760), as U. andropogonis October 15, 1892, (NY); Bartholomew as U. andropogonis, July 22, 1895; Bartholomew, as U. andropogonis, September 23, 1896. Wabaunsee Co.: Verna, Morton (Kansas Ustilaginae), as U. andropogonis, July 4, 1894.

on Andropogon hallii Hack.: Finney Co.: 10 mi S Garden City, Haard (7) and Kramer, October 10, 1961. Riley Co.: Manhattan, KSC grass plots, Rogerson and Pickett, August 1953. Seward Co.: Arkalon, Kellerman and Swingle (1333), as U. andropogonis, type collection, June 26, 1888, (NY).

on Andropogon scoparius Michx.: Greenwood Co.: Rogerson and Hansing, June 21, 1954.

5. Spacelotheca reiliana (Kuhn.) Clint. Jour. Myc. 8:141. 1902. (Plate II, Fig. 5).

Syn: Ustilago reiliana Kuhn. In Ragenh., Fungi Europ. No. 1988. 1875.

Ustilago reiliana Kuhn. feneae Pass. In Rubenh., Fungi Europ. No. 2096. 1876.

Sorosporium reilianum (Kuhn.) McAlp., Smuts Australia p. 181. 1910.

Sorus attacks entire inflorescence, single columella sometimes present, at first covered with a definite peridium



which soon ruptures to release the granular, dusty spore masses; sterile cells in subspherical groups or single, mostly subglobose to globose or ovoid, yellowish brown to dark reddish brown, 9-12 u in diameter, abundantly and conspicuously echinulate.

This species is relatively common but it has not been collected for the KSU Herbarium in recent times.

SPECIMENS EXAMINED:

on Sorghum vulgare L.: Riley Co.: Manhattan, KSAC, Norton (Kansas Ustilagineae), no date; Manhattan, Kellerman, on variety Early Amber, May 30, 1891; Manhattan, Kellerman and Swingle (2948), as Ustilago reiliana (Kuhn.) Norton. Rooks Co.: Stockton, Bartholomew (2280), Sept. 4, 1906, (NY).

on Zea mays L.: Morris Co.: Norton (Kansas Ustilagineae), as U. reiliana, July 1895. Republic Co.: Norton (Kansas Ustilagineae), as U. reiliana, Sept. 1895. Riley Co.: Manhattan, Norton (Kansas Ustilagineae), July 18, 1895; Manhattan, KSAC farm, Clothier (Kansas Ustilagineae, Norton), as U. reiliana, July 10, 1895; Manhattan, Norton (Kansas Ustilagineae), July 18, 1895. Saline Co.: Norton (Kansas Ustilagineae), as U. reiliana, Oct. 12, 1895.

6. Sphacelotheca sorghi (Link.) Clint., Jour. Myc. 8:140. 1902. (Plate II, Fig. 6.).

Syn: Ustilago sorghi (Link.) Pass. In Thum., Hedw. 12:114. 1873.

Sori in ovaries, replacing seeds, covered by a firm peridium which resembles rest of inflorescence; sterile cells of peridium breaking up into groups, hyaline, oblong to subglobose, mostly 7-18  $\mu$  in diameter; spores dark brown, around central columella of host tissue, globose to subglobose, oliveaceous brown, 5-8.5  $\mu$  in diameter (mostly 6-7  $\mu$ ), smooth to minute granular echinulations.

This smut is very close to Sphacelotheca cruenta and when on Sorghum halapense (L) Pers. is very difficult to differentiate. It differs from S. cruenta by having a tough and persistent peridium and slightly smaller spores.

SPECIMENS EXAMINED:

on Sorghum vulgare Pers.: Butler Co.: Peabody, Hollow and Jehle, on Sorghum sp., Sept. 1912; El Dorado, Rutherford and Jehle, on Sorghum sp., Sept. 1912. Garfield Co.: Farmen Leg Bartholomew, Oct. 1895. Riley Co.: Manhattan, Clothier (Fungi Columb. 1483), as Ustilago sorghi (Link.) Pass., (NY); Manhattan, White (29) on Sorghum sp., Oct. 27, 1921; Manhattan, KSAC greenhouse, Kellerman, as U. sorghi, May 30, 1891. Manhattan, KSAC greenhouse, Kellerman, on varieties Early Amber, Red Liberium, Kaffir Corn, Rangoon, as U. sorghi, (4 packets), May 30, 1891; Manhattan, Kellerman and Swingle (3094, 3092, 3091, 3089, 3091), as U. sorghi, Oct. 1890. Rooks Co.: Stockton, Bartholomew (Econ. Fung. 545) as U. sorghi (NY); Bartholomew, as U. sorghi, (2 packets), Nov. 14,

Plate II

Fig 1 Sphacelotheca andropogonis.

on Andropogon gerardi 4 X; spores 935 X.

Fig 2 Sphacelotheca oruenta.

on Sorghum sudanense 4 X; spores 935 X.

Fig 3 Sphacelotheca destruens.

on Panicum dicotomoflorum 4 X; spores 935 X.

Fig 4 Sphacelotheca occidentalis.

on Andropogon gerardi 4 X; spores 935 X.

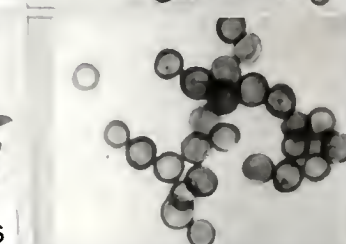
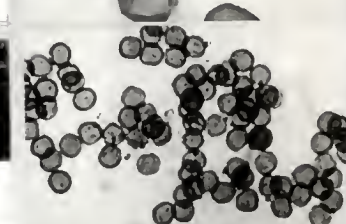
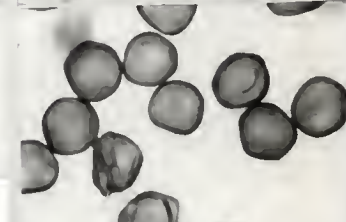
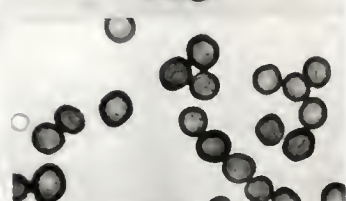
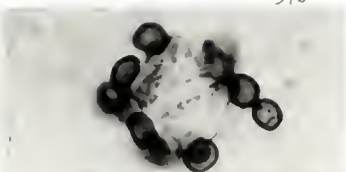
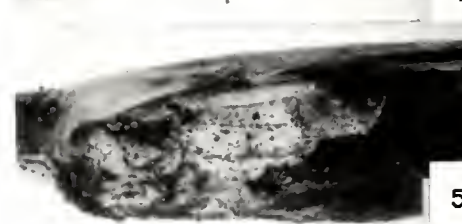
Fig 5 Sphacelotheca reiliana.

on Sorghum vulgare 2 X; spores 935 X.

Fig 6 Sphacelotheca sorghi.

on Sorghum vulgare 2 X; spores 935 X.

## PLATE II



1895, (NY); Bartholomew (Sydow Ustilagineae 63), as U. sorghi, Oct. 12, 1896; Bartholomew (Econ. Fungi 545), no date.

on Sorghum halapense. (L) Pers.: Barber Co.: W of Medicine Lodge, Rogerson, June 21, 1956. Clark Co.: S of Ashland, Rogerson, June 17, 1957. Ellis Co.: E of Oak Valley, Rogerson, June 11, 1957. Ellsworth Co.: Pady and Rogerson, Oct. 12, 1956. Greenwood Co.: W of Severy, Rogerson, June 11, 1957. Harber Co.: Rogerson, June 21, 1956. Labette Co.: W of Chetopa, Rogerson, June 11, 1957. Pottawatomie Co.: 2 mi E of Manhattan, Kinn and Rogerson, Oct. 11, 1955; 2 mi NE of Clebourne, Slagg and Rogerson, Aug. 25, 1953.

on Sorghum sp.: Pawnee Co.: Norton (Kansas Ustilaginae), Sept. 23, 1895. Phillips Co.: Norton (Kansas Ustilaginae), Sept. 23, 1895. Republic Co.: Norton (Kansas Ustilaginae), Sept. 23, 1895. Riley Co.: Norton (Kansas Ustilaginae), Sept. 23, 1895.

Tilletia Tul.

Ann. Sci. Nat. Bot. (III) 7:112-113. 1847.

TYPE SPECIES: Tilletia tritici (Djerk.) Wint.

Sori mostly in ovaries but occasionally in vegetative parts, forming a powdery or semi-agglutinated spore mass, often foetid, spores single, formed from intercalary cells

of a sporogenous mycelium or terminally on a sporogenous hypha, frequently with a more or less evident hyaline to tinted gelatinous sheath enveloping each spore, comparably large and regular, usually reticulate or spiny, rarely smooth, usually intermixed with a few to numerous immature or imperfect spores known as sterile cells.

This genus could be more abundant than is indicated in Kansas but due to its inconspicuous symptoms it can be easily overlooked when collecting.

#### Key to Species

1. Spores smooth, 17-22 u in diameter . . . . . T. foetida
1. Spores not smooth but variously sculptured . . . . . 2
  2. Spores more or less reticulate (sometimes reticulate pitted) . . . . . 6
  2. Spores marked other than with reticulations . . . . . 3
3. Spores with a distinct hyaline to tinted gelatinous sheath, usually extending beyond the sculpturings of the exospores . . . . . 4
3. Spores without any sheath, exposure with abundant and fine echinulations . . . . . T. maclagani
4. Spores verrucose, opaque dark brown . . T. pulcherrima
4. Spores tuberculate . . . . . 5
5. Sterile cells sheathed, sheath 2.5-5 u thick . . T. texana
5. Sterile cells not sheathed but with a very thick (4-9 u) wall . . . . . T. buchloeana
6. Spores 14-24 u in diameter including sheath if present . . . . . 7
6. Spores 22-36 u in diameter including sheath if present . . . . . T. fusca

7. Spore not sheathed, reticulations 0.5-1 u deep and variable in shape and size . . . . . T. caries
7. Spore sheathed, sheath 2.5-4 u thick . . . . T. redfieldiae
1. Tilletia buchloeana Kellerm. and Sw., Jour. Myc. 5:11. 1889. (Plate III, Fig. 1).

Sori in ovaries, replacing the seeds 1-2 mm. in length sometimes concealed by palea and lemma or concealed covered by the pericarp which easily ruptures to express the dark reddish brown spore mass; sterile cells variable in size but mostly smaller than the spores, with a very thick multilaminated wall, smooth; spores globose or subglobose to elongate, pale yellowish to yellow brown, 17-22 u in diameter, including the hyaline, gelatinous sheath, about 1.5 u thick, in which is embedded the short conical tubercles of the exospore, sometimes with a hyaline hyphal fragment attached.

on Buchloeae dactyloides (Nutt.) Englm.: Ford Co.: Bucklin, Kellerman and Swingle (1332), June 26, 1888, (NY).  
Jewell Co.: Dahl, summer 1894, (poor specimen). Riley Co.: Hackberry ravine, S. of Manhattan, Rogerson, June 10, 1956.  
Trego Co.: Kellerman and Swingle (1333), 1888, (NY).

2. Tilletia caries (D.C.) Tul., Ann. Sci. Nat. Bot. (III) 7:115. 1847. (Plate III, Fig. 2).

Syn: Tilletia tritici (Ejerk.) Wint., In Rabenh., Krypt. Fl. 1:110. 1881.

Sori in ovaries, foetid, replacing seed and giving the same general shape, sometimes larger, usually brown covered by a heavy peridium which is the pericarp of the ovary;

sterile cells few, globose to subglobose, hyaline, thin-walled, smooth 12-18 u in diameter; spores usually globose to subglobose, occasionally ovoid, light grayish brown to dark reddish brown, 14-23 u in diameter with reticulate exposure, varying from shallow pits to polygonal reticulations 0.5-1.2 u deep or, more or less cerebriform sculpturing.

SPECIMENS EXAMINED:

on Triticum aestivum L.: Ellsworth Co.: Ellsworth, Pady and Rogerson, June 11, 1955. Riley Co.: Upper Farm, Kellerman and Swingle, as Tilletia foetens, June 22, 1896, (the spores in this collection appear punctate but not reticulate). Boone Co.: Rockport, Bartholomew (1514), as Tilletia tritici (Ejerk.) Wint., July 14, 1894, (NY); Rockport, Bartholomew (1514), July 18, 1894.

3. Tilletia foetida (Wallr.) Liro., Maanviljekys. Talondellinen Koelaitos, Vvoskiviija 27:1915-1916. 1920. (Plate III, Fig. 3).

Syn: Tilletia laevis Kuhn In Rabenh., Fungi Europ. Cent 17 No. 1697. 1873 and Hedw. 12:152. 1873.

Tilletia foetens (Berk. and Curt.) Schrot. In Sohn, Beitr. Biol. Pfl 2:365. 1877.

Tilletia foetens (Berk. and Curt.) Trel., Trans. Wis. Acad. Sci. Art. Let. 6:139. 1884.

Sori in ovaries, foetid, replacing seeds and retaining their general shape, cylindric, greenish gray to brown, covered by the pericarp of the ovary, easily rupturing to release the grayish-black to black spore mass; sterile cells hyaline, thin walled, smaller than species, mostly about 14



u in diameter; spores globose to avoid or elongate, light grayish brown to dark olive brown, chiefly 17-20 u in diameter or 17-20 x 18-22, smooth.

SPECIMENS EXAMINED:

on Triticum aestivum L.: Douglas Co.: 9 mi N of Ft. Scott, Pady and Rogerson, on var. Early Triumph, June 2, 1955. Cherokee Co.: Rogerson, June 4, 1953. Leavenworth Co.: 2 miles W Jet on Hw. 192, Pady and Rogerson, June 10, 1957; E of McLouth, Pady and Rogerson, June 1955. Lyons Co.: W of Americus, Pady and Rogerson, June 3, 1955. Pawnee Co.: Jehle and Brown, June 26, 1913. Rooks Co.: Stockton, Bartholomew, (Fungi columb. 3288), August 8, 1910. Wyandotte Co.: N of Bonner Springs, Pady and Rogerson, June 2, 1955.

on Wheat: Riley Co.: Manhattan, Kellerman and Swingle, as Tilletia foetens (B. and C.) Trel, Summer 1890. Rooks Co.: Bartholomew (1513), as Turkish wheat, as Tilletia foetens (B. and C.) Schrod. July 16, 1894.

4. Tilletia macleanii (Derk.) Clint., Jour. Nyc. 8:148. 1902. (Plate III, Fig. 5).

Syn: Tilletia rotundata (Arth.) Ell. and Ev., N. Am. Fungi. No. 1894. 1887.

Tilletia rotundata (Arth.) Mass., Kew Bull. 153:145. 1899.

Sori in ovaries, replacing seeds, inconspicuous and rather well concealed under the palea and lemma; covered by the pericarp, spore masses dirty red brown; true sterile cells

few, pale yellow 17-19 u in diameter, globose, irregular or collapsed thick walled (2.5-4 u) smooth or obscurely papillose; spores pale yellowish, light yellowish brown to clear reddish brown, globose, subglobose or irregular 18-25 u in diameter, including the thick (2-3 u exospore), which is abundantly and finely verrucose, concolorous with the spore, apparently without a sheath.

The three Norton Kansas Ustilaginac collections labeled as Tilletia rotundata (Arth.) Ell. and Ev. were misidentified. They are actually Tilletia pulcherrima Ell. and Gall. and constitute the only Kansas collections of the fungus in the KSU Herbarium.

The Melchers and White (773) collection of 1915 was labeled as Tilletia pulcherrima but has been misidentified and is actually Tilletia maclagani. (Berk.) Clint. This is a new state record for this fungus.

The confusion seems to have been brought on by a specimen of the USDA Myc. Exch. of 1921 which were misidentified. There is a Tracy collection from Starkville, Mississippi (Econ. Fungi, Seymour and Earle No. 543), labeled as Tilletia rotundata = Tilletia maclagani. This is correct. The obvious duplicate of this collection was identified as Tilletia pulcherrima, (Starkville, Mississippi, Dupl. Econ. Fungi 543) issued by the USDA. This collection has been misidentified and is actually Tilletia maclagani.

SPECIMENS EXAMINED:

Riley Co.: Casement Ranch NE of Manhattan, White (773), misidentified as Tilletia pulcherrima Ell. and Gall, Nov. 11, 1915.

5. Tilletia pulcherrima Ell. and Gall. In Clint. Proc. Bot. Soc. Nat. Hist. 31:441. 1904. (Plate III, Fig. 5).

Sori in ovaries, replacing seeds, ovate or more elongated and somewhat curved, extending between lemma and palea 3-4 mm length, covered by remains of ovary wall, which upon rupture discloses blackish spore mass; sterile cells mostly globose to subglobose, pale yellowish sometimes papilliose 9-20 u in diameter, including the thick (1.5-2.5 u) hyaline, sometimes laminate wall; spores globose to subglobose, dark reddish brown and rather opaque when mature, 19-30 u in diameter, coarsely verrucose to cerebriform, the sculpturing embedded in a thin (1-1.5 u) pale yellow elatinois sheath.

SPECIMENS EXAMINED:

on Panicum virgatum L.: Riley Co.: Manhattan, Norton (Kansas Ustilaginae), Dec. 1895, misidentified as Tilletia rotundata E. and E.; Manhattan, Norton (Kansas Ustilaginae), October 7, 1895, misidentified as T. rotundata. Saline Co.: Henery, Norton (Kansas Ustilaginae), 1886.

TOLYPOSPORELLA Atkins

Bull. Cornell Univ. 3 (1): 16. 1897.

TYPE SPECIES: Tolyposporella chrysobogonis Atkin.

Sori usually in the leaves and sheaths as individual

linear striae or more often coalesced, granular to agglutinated, black; spores in balls or sometimes entirely separate; spores dark, with very thick (2-5 u), concentrically laminated exospores.

Only one species T. chrysopogonis, is known from Kansas, however, T. brunckii, which has been reported from Texas on Andropogon gerardi Vitm. should be looked for when collecting.

#### Key to Species

1. Spore balls firm; spores 11-16 u in diameter; on Sorghastrum . . . . . T. chrysopogonis
1. Spore balls indefinite, soon breaking up, may in fact not be true spore balls, spores 13-20 u in diameter; on Andropogon . . . . . T. brunckii
1. Tolyposporella chrysopogonis Atkins., Bull. Cornell Univ. 3:16. 1897. (Plate III, Fig. 6).

Sori on inner surface of leaf sheaths, evident on the outer surface only by discolored areas, spore masses are mostly granular, sometimes somewhat agglutinated, black; spore balls 45-75 X 55-135 u, yellowish brown, firm; spores globose to subpolyhedral, 11-16 u in diameter, yellowish brown, exospore smooth, thick (2.5-5 u), laminated, outer spores of balls often with excessively thickened exospores.

This species has been reported only from Sorghastrum nutans (L.) Nash.

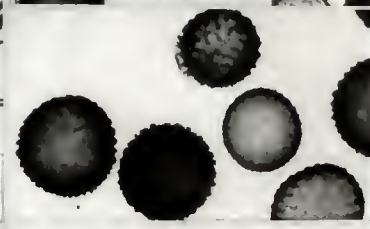
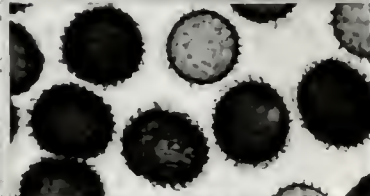
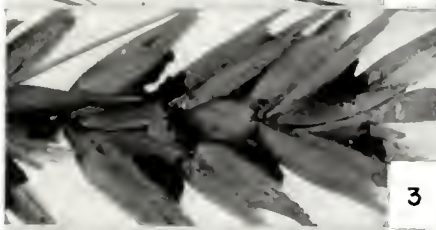
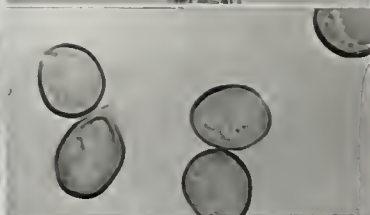
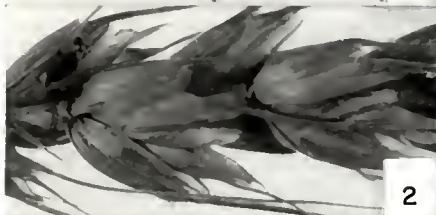
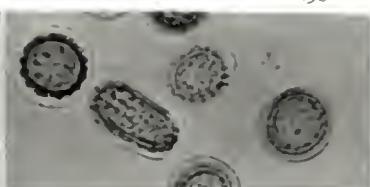
#### SPECIMENS EXAMINED:

on Sorghastrum nutans (L.) Nash: Riley Co.: Ashland Agronomy Farm, C. T. Rogerson, Oct. 1, 1951, (NY); Soil

Plate III

- Fig. 1 Tilletia buchloeana.  
on Buchloe dactyloides 4 X; spores 935 X.
- Fig. 2 Tilletia caries.  
on Triticum aestivum 4 X; spores 935 X
- Fig. 3 Tilletia foetida.  
on Triticum aestivum 4 X; spores 935 X.
- Fig. 4 Tilletia macalagani.  
on Panicum virgatum 4 X; spores 935 X.
- Fig. 5 Tilletia pulcherrima.  
on Panicum virgatum 4 X; spores 935 X.
- Fig. 6 Tolysporella chrysogonia.  
on Sorghastrum nuttans 4 X; spores 403 X.

## PLATE III



Conservation Nursery, Johnston, July 29, 1950. Sumner Co.:  
 South Haven, R. G. Frye, Oct. 15, 1938.

UROCYSTIS Rabenh.

In Klotzsch, Herb. Viv. Myc. II. No. 393. 1856.

Syn: Polycystis Lev., Ann. Sci. Nat. Bot. (III) 5:269.  
 1848. (Not Polycystis Kutzing, 1845).

Sori in vegetative parts of host in most species but some species develop sori in the reproductive parts of the host, spore mass dark brown to black, powdery to granular; spores contained in spore balls of one to many spores, firmly adhering, covered partially or completely by a layer of sterile cells (cortex) which are smaller, lighter colored and also firmly adhering; spore germination by a short to long basidium with a terminal whorl of a few to several primary basidiospores that fuse in pairs or basidium developing several branches and developing directly into a mycelium.

Five species of Urocystis are known for Kansas. The first Kansas record of a member of the genus was U. anemones by Norton in 1896. This may have been a report of Bartholomew's collection of this species on Anemone decapitata from Rocks Co., May 28, 1892. In this same publication Norton reported U. magica on onion, presumably the collections distributed by Bartholomew, have been found to be Aspergillus and not Urocystis.

In addition to the five known species from Kansas a number of others should be expected and looked for. These are all

included in the following key which has been adopted from Fischer (1953).

# Key to Species

1. Sori forming nodules or digitate swellings on roots on Descurainia . . . . . U. coralloides
1. Sori not on roots (occasionally on rootstock in U. violae) . . . . . 2
  2. Sori as long striae between the veins in leaves and sheaths and extending into aborted inflorescence, often confluent; on Gramineae . . . . . 3
  2. Sori in various other parts of the host (including Gramineae), or if as long striae, then not on Gramineae of Cyperaceae . . . . . 4
3. Spores incompletely invested by cortex of sterile cells; on Secale . . . . . U. occulta
3. Spores completely invested by sterile cortex; on many genera, but not Secale . . . . . U. agropyri
4. Spore balls containing mostly 1, but sometimes 2 or 3 spores . . . . . 5
4. Spore balls containing mostly 2-several spores . . . . . 6
5. Host in the Ranunculaceae; cortex of sterile cells only partially investing the spores . . . . . U. anemones
5. Host in the Liliaceae; cortex nearly completely investing the spores . . . . . U. colchici
6. Host in the Gramineae, Stipa . . . . . 7
6. Host not in the Gramineae . . . . . 8
7. Sori in the spikelets; spore balls containing mostly 4-8 spores; . . . . . U. granulosa
7. Sori in the contorted culms; spore balls mostly containing 10-20 spores; . . . . . U. fraseri
8. Host Violaceae . . . . . 9
8. Host Ranunculaceae . . . . . U. scoroparioides



9. Sori in ovaries or inner parts of flower; host Viola . . .  
 spp. . . . . U. kmetiana
9. Sori in vegetative parts of flower . . . . . U. violae
1. Urocystis agropyri (Preuss) Schrödt., Abh. Schles. Ges.  
 Abth. Nat. Med. (1869-1872), 7:1859. (Plate IV, Fig. 1).

Syn: Urocystis tritici Körn. Hedw. 16:33. 1877.

Sori as short to long striae, principally in leaves and sheaths, but often also in the rachis of the aborted inflorescence, black, at first covered by the host epidermis, frequently stunting the growth of the infected plants and causing distortion.

This species is reported by Fisher (1953) to have a very broad host range, thus it could be more widespread in Kansas and on many more host genera than indicated below by the list of specimens examined.

#### SPECIMENS EXAMINED:

on Agropyron smithii Rydb.: Russell Co.: 1 mi E of Lucas, Rogerson, June 3, 1957. Lincoln Co.: Rt. 18, 0.7 mi W of county line, Rogerson and Painter, May 7, 1956, (NY).

on Elymus canadensis L.: Dickinson Co.: 1 mi S of Herrington, Rogerson, May 29, 1957. Ness Co.: 12 mi W of Ness City, Rogerson, June 9, 1955. Rooks Co.: Stockton, Bartholomew (Sydow Ustilagineon 339), June 5, 1903; Stockton, Bartholomew (Fungi Columb. 1988), June 6, 1903; Stockton, Bartholomew (Sydow Ustilagineon 397), June 6, 1903, (NY).

Russell Co.: 6 mi S of Lucas, Rogerson, June 3, 1957.

on Elymus virginicus L.: Jackson Co.: along Elk Creek,

Rogerson and Hulbert, May 14, 1956. Riley Co.: along Wildcat Creek, Manhattan, Rogerson, May 19, 1953.

2. Urocystis anemones (Pers.) Wint. In Rabenh., Krypt. Fl. 1:123. 1881. (Plate IV, Fig. 2).

Sori in leaves, petioles and stems, forming conspicuous pustules of varying shapes and sizes, covered by the host epidermis but this soon rupturing and exposing the black powdery spore mass; spores in balls of 1-4 (6) surrounded by a more or less incomplete layer of investing sterile cells, spores reddish brown to chestnut brown, usually subglobose or with one or two flattened sides, easily separating from the spore balls, 13-18  $\mu$  in diameter, exospore 1-1.5  $\mu$  thick, smooth; sterile cells sometimes slightly smaller than spores but usually about the same size, lighter in color, yellowish brown, sometimes absent on spore balls. Occurring on members of the Ranunculaceae.

There have been a number of reports of this fungus from Kansas on two species of Anemone, A. caroliniana Walt. and A. decapetala Ard. However, duplicates of only one collection are present in the KSU and NY herbaria.

SPECIMEN EXAMINED:

on Anemone decapetala Ard., leaves and petioles: Rooks Co.: Rockport, Bartholomew (572), May 23, 1892.

3. Urocystis kmetiana Magn., Verh. Bot. Ver. Prov. Brandenb. 31:19. 1890. (Plate IV, Fig. 3).

Sori confined to ovaries, 3-5 mm in diameter, spore mass black, granular; spore balls composed of 3-12 spores surrounded by a layer of smaller, 5-10 (15)  $\mu$ , pale yellowish, sterile cells, spore balls globose to irregular 27-45 x 48-70  $\mu$ ; spores globose to flattened or angular in the interior of the spore ball, chestnut brown, 11-15  $\mu$  in diameter, smooth. Occurring on Violaceae.

This species was first reported for Kansas by Rogerson (1951) and this collection remains the only one known for the state. Fischer (1953) has reported it, also from Arkansas, Missouri and Tennessee, all on the same host.

SPECIMEN EXAMINED:

on Viola kitaibeliana R. and S. var. rafinesquii (Greene) Fern.: Riley Co.: Country Club Golf Course, Manhattan, Rogerson and Slagg, on Viola rafinesquii Greene, (duplicates in KSU, NY, Washington State College, B.P.I.), May 25, 1951.

4. Urocystis occulta (Wallr.) Rabenh., Klotzsch-Rabenh. Herb. viv. Mycol. Ed. 2:393. 1856.

Sori in leaves (especially on inner side of sheaths) culm and inflorescence, forming linear striae usually of great length and often merged into a continuous dusty, leaden to black spore mass; spore balls chestnut brown to olive brown globose, subglobose to somewhat elongate, 12-24 x 13-29  $\mu$ , composed of 1-5 spores (mostly 1-2) an incomplete cortex of much smaller, pale yellowish, thick walled sterile cells; spores globose, subglobose to slightly irregular, light olive

Plate IV

Fig. 1 Urocystis acropyri.

on Elymus canadensis 2 X; spores 403 X.

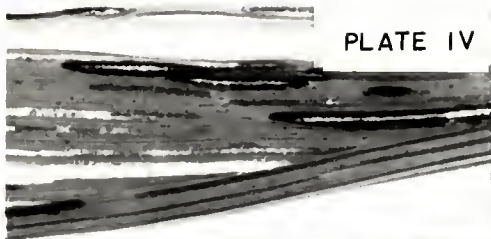
Fig. 2 Urocystis anemones.

on Anemone virginiana 2 X; spores 403 X.

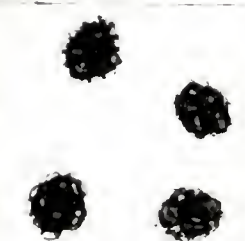
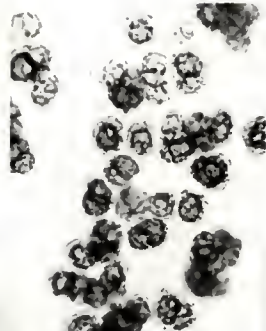
Fig. 3 Urocystis kmetiana.

on Viola kitabelliana var. rafinequii 2 X; spores 403 X.

PLATE IV



50b



brown to dark chestnut brown, 11-17 u in diameter, smooth.

Melchers reported this fungus for Kansas on Rye in 1919, but since there is no specimen on record in the K.S.U. herbarium. This species has not been examined, and must remain as an unsubstantiated record.

USTILAGO (Pers.) Roussel

In Flore du Calvados p. 47. 1806.

TYPE: Ustilago segetum Pers.

Syn: Uredo subgenus Ustilago Pers., Syn. Menth. Fungi p. 224. 1801.

Ustilagidium Herzob. In Zopf, Beitr. Morph. Phys. Nied. Org. 5:1-26. 1895.

Sori in all parts of host, forming brown powdery to agglutinated spore masses, sometimes dark brown to black and in some lighter colored yellowish, violaceous, purplish, etc; spores single, one-celled, small to medium in size (rarely over 20 u), smooth or sculptured, germination by means of a 2, 3, or 4 celled hypha, each cell producing a single celled sporidium, on germ tube.

Because of its complexities, the genus Ustilago is very difficult taxonomically. At our present state of knowledge, species are in some cases distinguished on a critical spore measurement or host specificity. The main problem is that a great overlapping of morphological characters exists in this complex group.

The present keys to the species are set up on the basis of the following characteristics:

Microscopic

Spore markings and shape  
 Spore measurements  
 Color of spore  
 Spore germination

Macroscopic

Host specificity  
 Size of sori and host reaction  
 Color of spore mass  
 Part of plant infected  
 Nature of peridium

Some of the characters listed here remain constant and are not variable, others will vary under certain circumstances and this fact should be taken into consideration when trying to separate various species.

Ustilago has been poorly represented in the KSU herbarium. Some species which have a wide host range are represented only by collections on one or so hosts. Others have not been collected in Kansas for 75 years even though they are apparently here. The distribution of Ustilago as well as most smut genera is unknown because of localized collecting.

Ustilago macrospora has been reported in the literature from Kansas but it is not represented in the herbarium. This species will remain on the list as unsubstantiated until material can be examined.

## Key to Species

1. Host not in family Gramineae . . . . . 2
1. Host in family Gramineae . . . . . 3
  2. Occurs on family Oxalidaceae; sori confined to ovaries; spores echinulate-verrucose, spore size? . . . . . U. oxalidis
  2. Occurs on family Polygonaceae; sori confined to ovaries; spores with large reticulations, 8-12 u in diameter . . . . . U. utriculosa

3. Sori usually in some part of the inflorescence . . . . . 4
3. Sori on various vegetative parts of the host . . . . . 18
4. Sori involve the entire inflorescence, sometimes completely destroying it . . . . . 13
4. Sori confined to individual ovaries or spikelets . . . 5
5. Spores smooth under oil immersion . . . . . 6
5. Spores variously marked . . . . . 7
6. Spores 5-8 u in diameter; not on Setaria . . . U. hordei
6. Spores 8-10 u in diameter; on Setaria . . . U. crameri
7. Spores mostly more than 12 u in diameter (11-19 u) . . . 8
7. Spores mostly less than 12 u in diameter (5-13 u) . . . 9
8. Spores marked with course pointed tubercles . . . . . U. sporoboli
8. Spore not marked with tubercles but coarsely verrucose . . . . . U. bullata var. macrospora
9. Spores with prominent echinulations . . . . . 10
9. Spores finely granular to verrucose, exospore sometimes with fine darker band . . . . . U. bullata
10. Sori on few ovaries; spores with prominent echinulations; on Eragrostis sp. . . U. spermophora
10. Sori tend to be on all ovaries; not on Eragrostis sp. . . . . 11
11. Sori covered with tough hispid peridium . . U. sphaerogena
11. Sori covered with peridium but not thin and hispid . . 12
12. Sori in ovaries and sometimes other parts, forms nodular galls at nodes of culm, leaf sheath covered by smooth peridium . . . . . U. heterogena
12. Sori in ovaries only usually involves entire spike, covered by thin peridium . . . . . U. neglecta
13. Spores smooth, 4-8 u in diameter; on Cynodon dactylon . . . . . U. cynodontis



13. Spores variously marked; not on Cynodon dactylon . . . 14
14. Exospore light colored on one side and more or less echinulate on that side . . . . . 15
14. Exospore more or less uniformly colored and sculptured . . . . . 16
15. Spore germinates by 3-4 celled promycelium and lateral sporidia . . . . . U. avenae
15. Spore germinating by germ tube and mycelium only . U. nuda
16. Spores 12-18 u in diameter, prominent echinulations; on Sporobolus . . . . . U. vilfae
16. Spore 8-13 u in diameter, prominently echinulate; on various grasses . . . . . 17
17. Spores 9-11 u in diameter, sparse but distinct echinulations . . . . . U. syntherismae
17. Spores prominently echinulate only; occasionally in leaves, but most frequently as galls at the nodes . . . . . U. heterogena
18. Sori in galls of one form or another . . . . . 19
18. Sori not in galls . . . . . 21
19. Galls large and conspicuous (up to 1 dm. and more in diameter); spores 7-10 u in diameter prominent echinulations . . . . . U. maydis
19. Galls smaller; spores 9-13 u in diameter, with sparse echinulations . . . . . 19
20. Galls covered by a hispid peridium . . U. crucealli
20. Galls covered by a smooth peridium . . U. heterogena
21. Sori in culms . . . . . 22
21. Sori in leaves . . . . . 24
22. Spores smooth (oil immersion) . . . . . 23
22. Spores with bipolar crests of echinulations . . . . . U. spegazzini

23. Spores with bipolar thickenings (oil immersion) . . . . . U. specazzini var. agrestis
23. Bipolar thickenings absent . . . . . U. hypodytes
24. Sori as sausage or blister like pustules on leaf surface, scattered . . . . . 25
24. Sori as short to long striae between the veins or confluent running into a more or less aborted in inflorescence . . . . . 26
25. Spores 7-11 u in diameter . . . . . U. minor
25. Spores 10-18 u in diameter . . . . . U. buchloes
26. Spores 10-13 u in diameter, echinulate . . . . . U. striiformis
26. Spores 14-19 u in diameter, strikingly echinulate-verrucose . . . . . U. macrospora

1. Ustilago avenae (Pers.) Rostr., Overs K. Danske Vid Selsk. Forh. 1890:13 (Mar). 1890. (Plate V, Fig. 1).

Syn: Ustilago setetum (Pers.) Nees. Syst. d. Pilze Abt. 1:13. 1837.

Sori in the inflorescences, mostly in ovaries and destroying floral parts, forming a dark brown almost black, usually loose and powdery spore mass; spores globose to subglobose or elongate, yellowish brown to olive brown, lighter on one side, minutely echinulate, echinulations usually more prominent on the lighter side, mostly 5-7 x 6-9 u in diameter.

SPECIMENS EXAMINED:

on Avena sativa L.: Allen Co.: E of Gas City, Pady and Rogerson, June 11, 1956. Bourbon Co.: W of Ft. Scott, Pady and Rogerson, June 11, 1956. Ellsworth Co.: Ellsworth,

Rogerson, June 10, 1954. Hamilton Co.: Coolridge, Hitchcock, Summer 1892. Jewell Co.: Mankato, Kern, June 23, 1891. Reno Co.: Hutchinson, Rogerson, June 5, 1953. Riley Co.: Manhattan, Norton and Clothier, no date; Manhattan, KSC Smut Nursery, on var. Beamer, Pady, June 14, 1946. Rooks Co.: Rockport, Bartholomew (255), June 25, 1892.

on Hordeum vulgare L.: Barton Co.: 10 mi. S. Albert, Pady and Rogerson, June 1956. Dickinson Co.: S of Herrington, Rogerson and Pady, June, 1956. Ellsworth Co.: Rogerson, June 1956.

2. Ustilago buchloes. Ell. and Tr., Jour. Myc. 6:77. 1890. (Plate V, Fig. 2).

Syn: Ustilago hieronymi Schrot., Hedw. 35:213. 1895.

Ustilago filifera Nort., Trans. Acad. Sci. St. Louis 7:237. 1896.

Sori in leaves forming sausage-like pustules, ovoid to linear 1-10 mm in length, at first covered by a thin grayish peridium, which soon ruptures to release granular blackish spore masses; spores globose, subglobose to ellipsoid or polyhedral, yellowish brown to rather opaque reddish brown, 10-18 u in diameter and up to 22 u in length, exospore appears smooth but under oil immersion appears minutely papillionose to echinulate.

#### SPECIMENS EXAMINED:

on Bouteloua curtipendula (Michx.) Torr.: Riley Co.: Manhattan, near Paw Paw Ravine, Rogerson, June 10, 1956; S of

Manhattan, Rogerson, Sept. 16, 1957; Rt. 13, 3 mi. S of Manhattan, Rogerson, July 8, 1957, (NY); Seandale, Kellerman and Swingle, as Ustilago perferans, Ell. and Ev., July 1889; Manhattan, Norton, as Ustilago filifera Norton, July 11, 1897, (NY); Manhattan, Bartholomew (39) as Ustilago hieronymi Schrot; Manhattan, Clothier, as U. filifera, August 23, 1895; Manhattan, Norton, as U. filifera, on Eutelous racemosa, August 9, 1895. Wabaunsee Co.: Norton, on Eutelous olicistachya as U. filifera, July 4, 1894.

3. Ustilago bullata Berk., In Hook., Fl. New Zealand 2:196. 1855. (Plate V, Fig. 3).

Syn: Ustilago bromivora (Tul.) Fisch. v. Waldh., Bull. Soc. Nat. Moscow 40:252. 1867.

Ustilago lorentziana Thum., Flora 63:30. 1880.

Ustilago bromivora Tul. var. brachypodii Har., Bull. Soc. Hist. Nat. Afr. Nord. 2:192. 1921.

Sori in spikelets, bullate, sometimes entirely involving the glumes but mostly only partially, enclosed in a grayish green peridium, the character of which varies with the host; spores powdery (occasionally agglutinated) dark brown to purplish black spore mass; globose to subglobose but sometimes irregular to polyhedral in agglutinated specimens, usually dark brown or olive brown, 6-11 u in diameter, but mostly 7-9 u; exospore varying from minutely echinulate to granular-verrucose, some have a dark equatorial band.

SPECIMENS EXAMINED:

on Bromus japonicus Thunb.: Clay Co.: S of Clay Center, Rogerson, June 26, 1957. Cloud Co.: Clyde, Rogerson, June 26, 1956. Decatur Co.: E of Oberlin, Rogerson, June 21, 1957. Dickinson Co.: 2 mi. W of Hopeks, Hulbert and Haard (11), June 24, 1958. Marion Co.: 12 mi. N. Hillsboro, Hulbert and Haard (10), June 24, 1958. Norton Co.: W of Norton, Rogerson, June 21, 1957. Riley Co.: 3 mi. SE of Manhattan, Rogerson, July 12, 1957; Manhattan, Johnson and Lefebvre, as Ustilago bromivora (Tul.) Fisch. v Waldh, (2 packetts), July 18, 1935; Manhattan, Ashland Agronomy Farm, Haskett and Rogerson, October, 1956; N of Manhattan, Rogerson, June 18, 1955, (NY). Sumner Co.: 7.2 mi. E on Roadside and Shelter belt, Rogerson and Hulbert, June 21, 1956.

on Bromus cartharticus Vahl.: Location? (Kansas): Johnson and Lefebvre, as U. bromivora, May 28, 1936.

on Hordeum hystrix Roth: Riley Co.: KSC Greenhouse, Manhattan, Johnson and Lefebvre, as Ustilago lorentziana Thun., June 29, 1934.

4. Ustilago crameri Körn., In Fekl., in Symb. Mycol. Nachtrag 2:11. 1873. (Plate V, Fig. 4).

Sori in spikelets, infecting entire spike, ovate, about 2-4 mm in length, destroying inner and basal parts; spores subglobose to ellipsoid and irregular, clear yellowish brown to olive brown, 7.5-10 u in diameter and up to 16 u in length, exospore smooth.

## SPECIMENS EXAMINED:

on Setaria italica (L.) Beauv.: Nemaha Co.: Wetmore, Achter and Rogerson, Summer 1951, (NY).

5. Ustilago cydonitis (Pass.) Henn., Bot. Jahrb. (Engler) 14:369. 1891. (Plate V, Fig. 5).

Sori in inflorescence, transforming branches into linear, dusty spore masses with floral parts all destroyed except the elongated crinkled rachis, sometimes destruction less complete and confined to lower spikelets, sori hidden at first by enveloping sheaths; spores mostly subglobose to globose, light yellowish brown, 5-8 u in diameter, exospore smooth.

## SPECIMENS EXAMINED:

on Cynodon dactylon (L.) Pers.: Barber Co.: Medicine Lodge, Rogerson and Benefil, Sept. 24, 1954. Summer Co.: Cemetery, Wellington, R. Frve, August 25, 1954; W of Arkansas City, Rogerson, May 5, 1953, (NY).

6. Ustilago heterogena Henn., Hedw. 43:155. 1904. (Plate V, Fig. 6).

Syn: Ustilago pustulata Torr. and Earle, Bull. Torr. Bot. Club 22:175. 1895. (Not U. pusulata (DC.) Wint. 1880).

Sori in various parts of the host, in ovaries or stamens as ovate bodies 2-4 mm in length, or frequently as conspicuous nodular galls at the nodes of the culm, or on leaf sheaths, covered by a firm peridium which ruptures to release dark brown, powdery to granular spore masses; spores mostly globose

Plate V

Fig. 1 Ustilago avenae.

on Avena sativa 2 X; spores 935 X.

Fig. 2 Ustilago buchloes.

on Bouteloua curtipendula 4 X; spores 935 X.

Fig. 3 Ustilago bullata.

on Bromus japonicus 4 X; spores 935 X.

Fig. 4 Ustilago crameri.

on Setaria italica 2 X; spores 935 X.

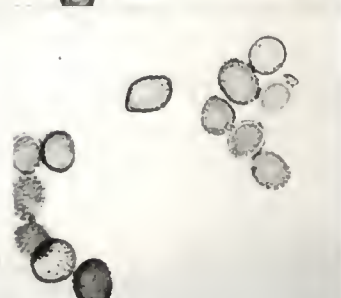
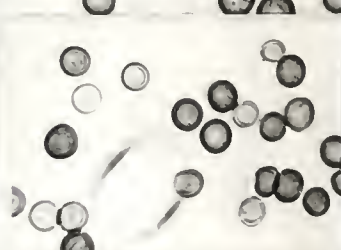
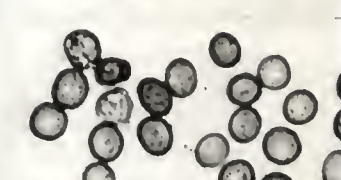
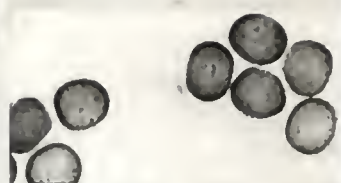
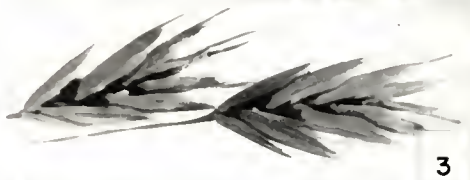
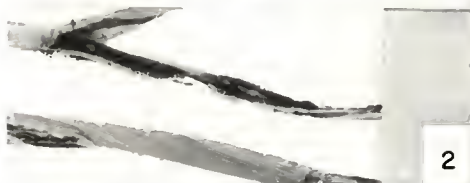
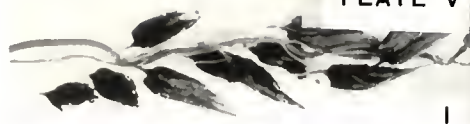
Fig. 5 Ustilago cynodontis.

on Cynodon dactylon 2 X; spores 935 X.

Fig. 6 Ustilago heterogena.

on Panicum virgatum 4 X; spores 935 X.

## PLATE V





or subglobose some ovoid to polyhedral, light yellowish brown to light olive brown, 9-14 u in diameter, conspicuously but sparsely echinulate.

SPECIMENS EXAMINED:

on Panicum dictomoflorum Michx.: Pottawatomie Co.:  
Norton, as Ustilago, Torr. and Earle., Sept. 15, 1895.  
Riley Co.: Manhattan, Swingle (ex Bartholomew, Fungi Columb. 3299), as U. pustulata, October 13, 1910; Manhattan, Swingle (ex Bartholomew, Fungi Columb. 3299), on Panicum proliferum Lam., October 13, 1910.

7. Ustilago hordei (Pers.) Lagerh., Mitt. Badischen. Bot. Ver. p. 70. (Mar.). 1889. (Plate VI, Fig. 1).

Syn: Ustilago hordei (Pers.) Lagerh. var. tecta Jens., Le Charb. Cerial p. 4. 1889.

Ustilago avenae (Pers.) Rostr. var. levis Kellerm. and Sw., Ann. Rep. Kansas Agri. Exp. Sta. 2:259. 1890.

Ustilago levis (Kellerm. and Sw.) Magn., Ber. Natur-Wiss-Mediz. Ver. Innsbruck. 21:33. 1894.

Sori in spikelets, more or less hard and compact, somewhat concealed by palea and lemma in some hosts, in other hosts the palea and lemma are consumed and the sori are covered with a delicate peridium which soon fragments and exposes a granular to agglutinated dark brown to black spore mass; spores globose to subglobose, light olive brown to brown, lighter color on one side, 5-8 u in diameter, exospore smooth.

SPECIMENS EXAMINED:

on Avena sativa L.: Lyon Co.: Americus, Conan, Ustilago

avenae var. levis, June 23, 1889. Riley Co.: Manhattan, Kellerman and Swingle (1935 and 1936) as Ustilago avenae, July 9, 1889; Manhattan, KSAC Farm on Barley, Kellerman and Swingle (1933) as Ustilago tecta Jens. Location? (Kansas): as Ustilago levis, Pady, June 21, 1940.

on Hordeum vulgare L.: Barton Co.: 4 mi NW of Great Bend, Rogerson, June 9, 1955. Decatur Co.: E of Oberlin, Rogerson, June 9, 1955. Greeley Co.: Tribune, Rogerson, June 9, 1954. Labette Co.: Mound Valley, Rogerson, June 6, 1953. Sedgwick Co.: Wichita, Experiment Station, Pady, May 19, 1944. Wabaunsee Co.: 1.5 miles E of Wabaunsee, Rogerson, June 1, 1957.

8. Ustilago hypodytes (Schlecht.) Fries, Syst. Myc. 3:518. 1832.

Sori naked, surrounding the internodes and sometimes extending into aborted inflorescence, enclosed at first by leaf sheaths, dusty, dark brown; spores globose to subglobose, yellowish brown to oliveaceous brown, chiefly 4-5 u in diameter of 3-4 x 5-6 u, exospore smooth.

No specimens for Kansas are available in the KSU Herbarium. This was reported by Bartholomew (1927) with no reference to host or herbarium specimen. U. hypodytes must remain on the list as an unsubstantiated species.

9. Ustilago macrospora Desm., Pl. Crypt. de France. No. 2127. 1851. (Plate VI, Fig. 2).

Sori principally in leaves and leaf sheaths, but also sometimes extending into the more or less aborted inflorescence, involving the rachis, linear brown almost black spore masses, giving the leaves a shredded appearance after spore dispersal; spores chiefly globose or subglobose, sometimes elongate usually dark brown and prominently verrucose chiefly 14-19 u in diameter.

SPECIMENS EXAMINED:

on Elymus virginicus L.: Sherman Co.: 10 mi. S of Goodland, Rogerson, June 19, 1956.

10. Ustilago maydis (DC) Oda., Icones Fung. 5:3. 1842.  
(Plate VI, Fig. 3).

Syn: Ustilago zeae (Schw.) Ung., Ein. fl. Bodens. p. 211. 1836.

Ustilago mays-zeae (DC.) Magn., Verh. Bot. ver. Prov. Brandenb. 37:72. 1895.

Sori in various parts of the host, evident as small to large prominent galls, first covered by a delicate membrane, which ruptures to disclose olive green dusty spore masses; spores mostly globose to subglobose, light olive brown, rather prominently echinulate, chiefly 7-10 u in diameter. This species is obviously common in the state of Kansas and an effort should be made to obtain better representation in the K.S.U. herbarium.

SPECIMENS EXAMINED:

on Euchanena mexicana Schrad.: Riley Co.: Kellerman and Swingle (Kansas Fungi 25), as Ustilago zeae-mays, on

Euchaena luxuriana Duvieu and Aschers, Sept. 11, 1883, (NY).

on Zea mays L.: Riley Co.: Manhattan, Norton (Kansas Ustilaginae), March 1894; Manhattan, Norton (Kansas Ustilaginae), 1895; Olatha, collector unknown, Summer 1892. Rocks Co.: Stockton, Bartholomew (Fungi Columb., 2700), as Ustilago zeae, July 28, 1908; Rockport, Bartholomew (444), as U. zeae, August 1, 1891; Rockport, Bartholomew (Sydow Ustilagineen), November 13, 1897.

11. Ustilago minor Nort., Trans. Acad. Sci. St. Louis 7:238. 1896. (Plate VI, Fig. 4).

Syn: Ustilago hieronymi Schrot. var. minor Cif., Trans. Brit. Myc. Soc. 18:262. 1934.

Sori in leaves and leaf sheaths, forming ovoid to linear pustules, 1-5 mm or even longer, covered at first with a brittle peridium, which soon ruptures, exposing a dark spore mass; spores mostly globose or subglobose, but some ellipsoid or elongate, yellowish to light reddish brown, 7-11 u in diameter, fine and sparse echinulations.

#### SPECIMENS EXAMINED:

on Bouteloua hirsuta Lag.: Riley Co.: Manhattan, Thompson and Norton, 1896. This is possibly the type specimen.

12. Ustilago neglecta Niessl. In Rabenh., Fung. Europ. No. 1200. 1866. (Plate VI, Fig. 4).

Syn: Ustilago boutelouae Kell. and Swing., Jour. Myc. 5:13. 1899.

Ustilago panicis-glauci (Wallr.) Wint. In Rabenh., Krypt.-Fl. 1:97. 1881.

Sori in spikelets, involving all the spike, at first covered by a thin peridium, which soon ruptures to release dusty, dark purplish brown spore masses; spores light reddish brown to olive brown, irregularly globose to ovoid and elongate, rather prominently echinulate, 7-11 x 9-12 u.

SPECIMENS EXAMINED:

on Bouteloua gracilis (H.B.K.) Lag: Ford Co.: 10 mi S of Spearville, McGregor (11027), (NY). Kingman Co.: Kingman, Lefebvre, Dec. 17, 1936. Hess Co.: McCracken, Hansing and Rogerson, as Ustilago boutelouae, Sept. 28, 1950. Riley Co.: Manhattan, Norton, on Bouteloua oligostachya, Torr. ex Gray, as U. boutelouae, 1895; Manhattan, Kellerman and Swingle (1335), Dec. 20, 1888, (NY). Rooks Co.: Stockton, Bartholomew (48, U.S.D.A. Mycol. Exch. of 1921), on Bouteloua oligostachya, as U. boutelouae, August 15, 1921; Rockport, Bartholomew (305), as U. boutelouae, on Bouteloua oligostachya, Sept. 9, 1889.

on Bouteloua hirsuta Lag.: Clark Co.: 5 mi E of Ashland, Kramer (2515) and Duffield, Sept. 4, 1958, (NY). Rush Co.: 16 mi S of LaCrosse, Kramer (2516) and Duffield, Sept. 4, 1958, (NY).

on Setaria lutescens Weigel: Riley Co.: Manhattan, Coll. Botanical Dept. (1723), as Setaria glauca Beauv., date unknown; Bartholomew (Fungi Columb., 1700), as Ustilago panici-glauci, August 29, 1902; Manhattan, Johnson and White,

Sept. 16, 1921; Manhattan, Norton, Sept. 1896; Manhattan, Thompson, Setaria glauca, August 4, 1891.

13. Ustilago nuda (Jens.) Rostr., Tidsskr. f. Landokon. 8:745. 1889. (Plate VI, Fig. 6).

Syn: Ustilago segetum (Pers.) Ditmar var. hordei f. nuda Jens., Om Kovns Brand p. 61. 1888.

Ustilago segetum (Pers.) Ditmar var. tritici Jens., Jour. Roy. Agric. Soc. Engl. (II) 24:407. 1888.

Ustilago segetum (Pers.) Ditmar var. nuda Jens., Jour. Roy. Agric. Soc. Engl. (II) 24:406. 1888.

Ustilago hordei (Pers.) Lagerh. var. nuda Jens., Charb. Cereales p. 4. 1889.

Ustilago nuda (Jens.) Kell. and Sw., Ann Rept. Kan. Agric. Expt. Sta. 2:227. 1890.

Ustilago tritici Jens. In Kellerm. and Sw., Ann. Rept. Kans. Agric. Expt. Sta. 2:262. 1890.

Ustilago nuda (Jens.) Kellerm. and Swingle var. follicola Trott., Ann. Myc. 11:415. 1913.

Sori in spikelets, very loose and dusty, oliveaceous brown to almost black, usually destroys floral parts entirely; spores globose to subglobose or ovoid, clear oliveaceous brown, lighter on one side, minutely echinulate with echinulations more prominent on lighter side, chiefly 5-8  $\mu$  in diameter.

#### SPECIMENS EXAMINED:

on Hordeum vulgare L.: Coffee Co.: Burlington, Shawbaugh, May 3, 1955; Burlington, Rogerson and Hansing, June 4, 1953. Hamilton Co.: Coolridge, Mitchcock, Summer 1892. Rooks Co.: Stockton, Bartholomew, (Fung. Columb.), June 1, 1905. Thomas Co.: Colby, Rogerson, June 9, 1954.

Plate VI

Fig. 1 Ustilago hordei

on Hordeum vulgare 2 X; spores 935 X.

Fig. 2 Ustilago macrospora.

on Elymus canadensis 4 X; spores 935 X.

Fig. 3 Ustilago maydis.

on Zea mays 2 X; spores 935 X.

Fig. 4. Ustilago minor.

on Bouteloua hirsuta 4 X; spores 935 X.

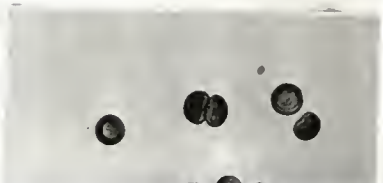
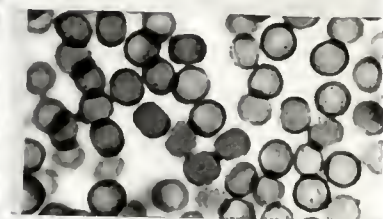
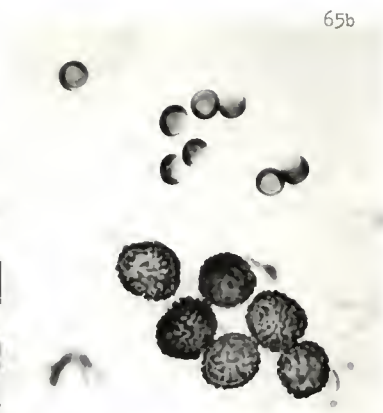
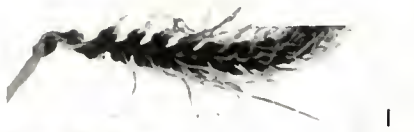
Fig. 5 Ustilago neglecta.

on Bouteloua hirsuta 4 X; spores 935 X.

Fig. 6 Ustilago nuda.

on Triticum aestivum 2 X; spores 935 X.

## PLATE VI





on Triticum vulgare L.: Cherokee Co.: Rt. 103, Pady and Rogerson, on Beardles wheat, June, 1955. Ellis Co.: Hays, Rogerson, Kiowa wheat, June 1956. Hutchinson Co.: Hutchinson Exp. Field, Pady and Rogerson, May 27, 1954. Jackson Co.: 12 mi W of Holton, Pady and Rogerson, June 2, 1955. Linn Co.: Route 6, Pady and Rogerson, June 2, 1953. Ottawa Co.: Ottawa, Pady, June, 1940 (2 packets). Riley Co.: Manhattan, Kellerman and Swingle, (Kansas Fungi), on variety 12 Ontario, June 25, 1890; Manhattan, Thompson (126), June 21, 1892; Thompson (Kansas Fungi Fascicle 1, 27), June 20, 1892; St. George, McCormick, May 23, 1891. Rooks Co.: Bartholomew, June 1898; Rockport, Bartholomew (167), June 14, 1892; Rockport, Bartholomew (619), June 14, 1898; Rockport, Bartholomew (255), June 14, 1892. Shawnee Co.: S of Topeka, Rt. 75, Rogerson, June 4, 1953. Woodson Co.: Griffin, McCormick (6), Faltz wheat, June 6, 1891.

14. Ustilago oxalidis Ell. and Tr. Jour. Myc. 6:77. 1890. (Plate VII, Fig. 1).

Sori in seeds, inconspicuous, with affected ovaries scarcely differing from normal except on dehiscence showing the seeds changed into reddish brown, dusty, spore masses slightly larger than uninfected seeds; spores mostly globose to subglobose, light brownish yellow, 12-15 u in diameter, echinulate-verrucose.

SPECIMEN EXAMINED:

on Oxalis stricta L.: Douglas Co.: Lawrence, Guy West

Wilson (K136), June 9, 1918.

15. Ustilago sphaerogena Burr. In Sacc. Syll. Fung. 7:468.  
1888.

Sori in ovaries, ovate 4-10 mm in length, covered with a tough hispid peridium; spores globose, subglobose, to ellipsoid or ovoid, light olive brown, 6.5-11 u, with sparse but sharp echinulations.

The hosts of the two specimens examined under this species were identified as Echinochoa crussalli (L.) Beauv. This host has been misidentified and is Sorghum halepense L. This species is thus placed in Sphacelotheca cruenta (Kuhn) Potter. Therefore U. sphaerogena has not been found in Kansas, but is included here for clarification.

16. Ustilago spermophora Durk. and Curt. In Sacc., Syll. Fung. 7:466. (Plate VII, Fig. 2).

Sori in ovaries, usually infecting only a few of the spikelets, ovate, small, 1-2 mm in length, sometimes bearing remains of unaffected part of ovary at apex, thin peridium ruptures to release dark brown spore masses; spores globose, subglobose, to ovoid or ellipsoid, light olive brown, 6.5-13 u in diameter, with prominent echinulations.

SPECIMENS EXAMINED:

on Eragrostis cilianensis (All.) Lutati.: Riley Co.:  
Manhattan, Thompson, on Eragrostis major, Oct. 7, 1891;  
Manhattan, Norton, (Kansas Ustilaginae), on E. major, Sept.  
28, 1895. Rocks Co.: Bartholomew, on E. major, Sept. 16,

1891, (NY).

17. Ustilago striiformis (Westend.) Niessl., Hedw. 15:1.  
1876. (Plate VII, Fig. 4).

Syn: Ustilago johnstonii Cif. Nuovo. biorn. Bot. Ital.  
40:261. 1933.

Sori in leaves and sheaths and extending into aborted inflorescences, involving the rachis, forming short striae between the veins, covered by host epidermis at first, leaves become shredded after spore dispersal; spores chiefly globose to subglobose or ellipsoid, rather dark olive brown, more or less prominently echinulate, 9-11 u in diameter.

SPECIMENS EXAMINED:

on Dactylus glomeratus L.: Pottawatomie Co.: State Park, Rogerson, May 8, 1954, (NY). Riley Co.: KSC Campus, Manhattan, Rogerson, Nov. 1, 1954; KSC Campus, Manhattan, Rogerson, Oct. 13, 1957; Manhattan, in lawn, Rogerson, May 3, 1957.

on Elymus virginicus L.: LaBette Co.: E of Parsons, Rogerson, as Elymus sp., June 3, 1955. Marshall Co.: SE of Irving, Rogerson, June 6, 1957. Riley Co.: Riley, Lefebvre, July 8, 1935.

on Poa compressa L.: Riley Co.: Along Wildcat Creek, W of Manhattan, Rogerson, May 28, 1953.

on Poa pratensis L.: Pawnee Co.: Larned, Manney, April 30, 1952. Riley Co.: KSU Campus and City Park, Manhattan, Rogerson, May 6, 1954; Manhattan, Rogerson, April 17, 195

18. Ustilago syntherismae (Schw.) Peck., Ann. Rept. N.Y. State Mus. 27:103. 1875. (Plate VII, Fig. 3).

Syn: Ustilago rabenhorstiana Kuhn, Hedw. 15:4. 1876.

Sori usually involving the entire inflorescence, linear oblong, 3-5 cm in length, at first hidden by enveloping leaf sheaths, but finally more or less visible as a blackish brown mass of spores surrounding the remains of the inflorescence; spores variable, globose to elongate, light to dark olive brown, 7-13 u in diameter, minutely echinulate.

SPECIMENS EXAMINED:

on Digitaria sanguinalis (L.) Scop.: Pottawatomie Co.: Louisville, Bartholomew (Fungi Columb. 2297), as Ustilago rabenhorstiana Kuehn, on Syntherisma sanguinalis, Oct. 26, 1906. Riley Co.: Manhattan, KSC Campus, Rogerson, October 2, 1954; Manhattan, Norton, as Sorosporium synthersimae, August 24, 1895; Manhattan, Norton, as Ustilago spp. Panicum sanguinale L., August 26, 1895; Manhattan, Kellerman (7792), on P. sanguinale, Oct. 1885, (NY); Manhattan, Kellerman, on P. sanguinale, Sept. 25, 1895 (2 packets); Manhattan, Thompson (114), P. sanguinale, Oct. 6, 1891; Manhattan, Thompson (112), on P. sanguinale, August 25, 1891; Manhattan, Taylor and Lefebvre, on S. sanguinealis as U. rabenhortiana Kuehn, Sept. 8, 1933; Manhattan, Botanical Dept. (1721) on P. sanguinale as U. rabenhorstiana; Manhattan, Thompson Leg Bartholomew (Kansas Fungi-fas. I) as U. rabenhorstiana.

19. Ustilago utriculosa (Nees.) Ung., Eingl. d. Bot. 211.  
1836. (Plate VII, Fig. 5).

Syn: Ustilago (Nees.) Tul., Ann. Sci. Nat. Bot. (111)  
7:102. 1847.

Sori in the ovaries, covered at first by a thin peridium (the epidermis of the ovary), which soon ruptures to expose the powdery, violaceous brown spore mass; spores globose to subglobose, some ovoid, 8-12 (14)  $\mu$  in diameter, light yellowish, exospore with deep reticulations forming polygonal patterns. Occurs on Polygonaceae.

SPECIMENS EXAMINED:

on Polygonum pennsylvanicum L.: Pottawatomie Co.:  
Belvue, Bartholomew (Fungi Columb. 2298), Sept. 27, 1906.  
Riley Co.: Manhattan, Thomson, (Kansas Fungi-Fas. I, 33),  
June 29, 1891; Manhattan, Norton, (Kansas Fungi-Fas. I, 44),  
Oct. 25, 1895; Manhattan, Pavrie, Oct. 6, 1894.

on Polygonum punctatum Ell. Barten Co.: Hitchcock  
on Polygonum acre H.B.K., Aug. 1895. Rooks Co.: Bartholomew,  
on P. acre, Oct. 3, 1891; Stockton, Bartholomew (Fungi Columb.  
2196 and Sydow, Ustilagineen 408), on P. acre, Oct. 2, 1905.

20. Ustilago vilfae Wint., Bull. Torr. Bot. Club. 10:7.  
1883. (Plate VII, Fig. 6).

Sori converting the inflorescence into an elongated, dusty spore mass, covered at first with a green peridium, more or less hidden at first by the enveloping leaf sheath; spores globose, subglobose, ovoid, ellipsoid to somewhat irregular,

yellowish brown to light reddish brown, 11-16 u in diameter and up to 20 u in length, abundantly echinulate-verrucose.

SPECIMENS EXAMINED:

on Sporobolus vaginiflorus (Torr.) Wood: Riley Co.:  
Manhattan, Worton (Kansas Ustilaginae), Dec. 1895; Manhattan,  
Swingle (1142), Dec. 1887.

Plate VII

Fig. 1 Ustilago oxalidis.

on Oxalis stricta 4 X; spores 935 X.

Fig. 2 Ustilago spermophora.

on Eragrostis ciliaensis 4 X; spores 935 X.

Fig. 3 Ustilago synthersmiae.

on Digitaria sanguinalis 2 X; spores 935 X.

Fig. 4 Ustilago striiformis.

on Bouteloua curtipendula 4 X; spores 935 X.

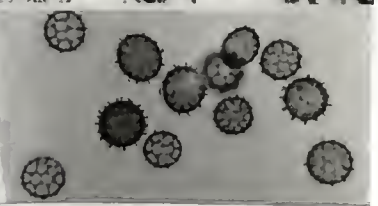
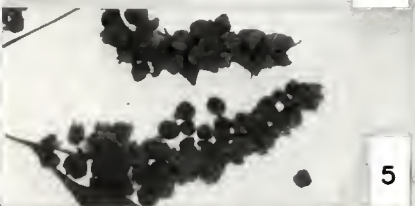
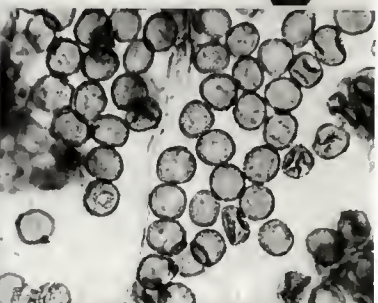
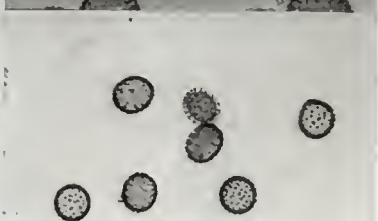
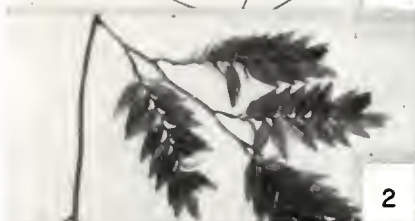
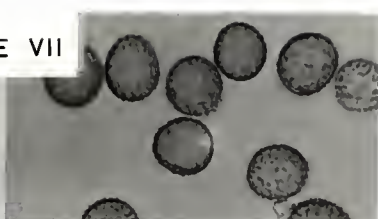
Fig. 5 Ustilago utriculosa.

on Polygonum pennsylvanicum 2 X; spores 935 X.

Fig. 6 Ustilago vilfae.

on Sporobolus vaginiflorus 4 X; spores 935 X.

## PLATE VII





## Part II THE GRAMINACEOUS RUST FUNGI OF KANSAS

This section contains a treatment of the rust fungi similar to that of the smut fungi presented in the previous section. Since there are only two genera which attack grasses in Kansas, Puccinia and Uromyces, a key to the genera will be omitted. In addition, due to difficulty to constructing a useful key to the species of Puccinia and Uromyces, and because of the difficulty in using such a key, this too has been omitted from the manuscript. All species are keyed in the following pictorial key using the host genera as the primary separation point.

### Host Genus Index and Key to the Gramineaceous Rust Fungi of Kansas

This key is based on the form used by Fisher (1953) in his treatment of the smut fungi of North America. Each host genus is listed alphabetically, and the rust species which occur or that could possibly occur on them in Kansas are keyed under each listing. The species with solid underlining are those that have been reported for Kansas on the host genus under which it is included. The species with dash underlining are those which have not been reported from Kansas on the particular host in question but in the opinion of the author, may possibly occur in the state. These are for the most part species with host genera that occur in Kansas and that have been reported on these hosts from surrounding areas. Those

species with an asterisk have been reported only on the alternate host in Kansas and therefore should be expected to occur also on the graminaceous host.

The pictorial illustrations in this key should not supply any more information than general size and shape of the spores. It must be kept in mind that the morphological characters of these rusts are extremely variable. No attempt has been made to present a "representative" sample of each rust species. Therefore, in using this key the illustrations should be used only in conjunction with the written portion and not as a sole means of identification.

The uredial groupings as proposed by Cummins (1956) are used throughout this key and in species descriptions. These groupings are characterized as follows:

- Group I      Uredia with paraphyses; urediospores echinulate;  
                 pores equatorial.
- Group II     Uredia with paraphyses; urediospores echinulate;  
                 pores scattered.
- Group III    Uredia with paraphyses; urediospores verrucose;  
                 pores equatorial (a hypothetical group).
- Group IV     Uredia with paraphyses; urediospores verrucose;  
                 pores scattered.
- Group V      Uredia without paraphyses; urediospores echinulate,  
                 pores equatorial
- Group VI     Uredia without paraphyses; urediospores echinulate;  
                 pores scattered.
- Group VII    Uredia without paraphyses; urediospores verrucose;  
                 pores equatorial.
- Group VIII   Uredia without paraphyses; urediospores verrucose,  
                 pores scattered.

Group IX      Uredia not developed or unknown; species of  
                 uncertain characteristics.

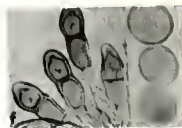
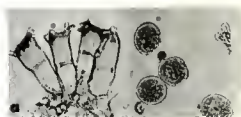
# Aegilops

1. Telia covered; Group VI . . . . . 2
1. Telia naked; urediospores 13-23 x 23-40  $\mu$ ;  
Group V . . . . . P. graminis (a)
2. Sori in lines; urediospores 19-29  
x 19-30  $\mu$ , wall hyaline; Group VI  
. . . . . P. striiformis (b)
2. Sori scattered; urediospores  
14-32 x 16-48  $\mu$ , wall yellow to  
cinnamon; Group VI... P. recondita (c)



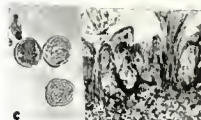
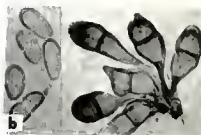
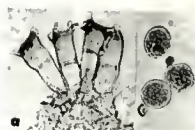
# Agropyron

1. Telia covered; Groups II, VI . . . . . 2
1. Telia naked . . . . . 5
2. Teliospores coronate; urediospores  
13-26 x 14-36  $\mu$ ; Groups II, VI . .  
. . . . . P. coronata (a)
2. Teliospores not coronate . . . . . 3
3. Group II; urediospores 19-26 x 21-32 $\mu$   
. . . . . P. montanensis (b)
3. Group VI . . . . . 4
4. Sori in lines; urediospores 19-29  
x 19-30  $\mu$ , wall hyaline . . . . .  
. . . . . P. striiformis (c)
4. Sori scattered; urediospores 14-32  
x 16-48  $\mu$ , wall yellow to cinnamon  
. . . . . P. recondita (d)
5. Teliospores coronate; urediospores 13-26  
x 14-36  $\mu$ ; Groups II, VI. . . . .  
. . . . . P. coronata (a)
5. Teliospores not coronate . . . . . 6
6. Group V; teliospores 16-23 x 35-55  
 $\mu$ , apex 5-10  $\mu$  . . . . . P. graminis (e)
6. Group VI; teliospores 16-23 x 29-37  
 $\mu$ , apex 1-1.5  $\mu$ , striate . . . . .  
. . . . . P. pattersoniana (f)



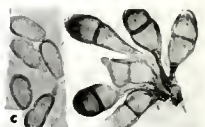
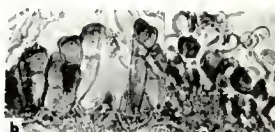
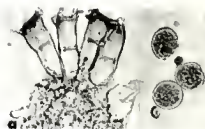
# Agrostis

1. Teliospores coronate; telia covered or naked; urediospores 13-26 x 14-36  $\mu$ ; Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Telia covered; Group VI . . . . . 3
2. Telia naked; urediospores 13-23 x 23-40  $\mu$ ; Group V . . . . . P. graminis (b)
3. Apex of teliospore often angular; urediospores 18-23 x 23-30  $\mu$ , wall hyaline to yellow; . . . . . P. liliatridis\* (c)
3. Apex of teliospore rounded to flattened; urediospores 14-32 x 16-18, wall yellow to cinnamon; . . . . . P. recondita (d)



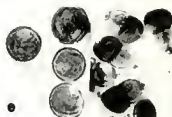
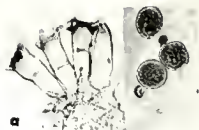
# Alopecurus

1. Teliospores coronate; telia covered or naked; urediospores 13-26 x 14-36  $\mu$ ; Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group II; urediospores 17-24 x 22-29  $\mu$  . . . . . P. poae-nemorialis (b)
2. Groups V, VI . . . . . 3
3. Group V; urediospores 13-23 x 23-40  $\mu$  . . . . . P. graminis (c)
3. Group VI . . . . . 4
4. Teliospores single celled; urediospores 14-25 x 17-19  $\mu$  . . . . . U. dactylidis (d)
4. Teliospores double celled; urediospores 14-32 x 16-48  $\mu$  . . . . . P. recondita (e)



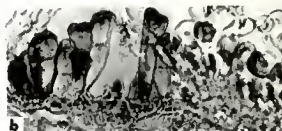
## Andropogon

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group VII . . . . . 3
2. Groups V, VI . . . . . 4
3. Teliospores single celled; urediospores  $13-17 \times 16-19 \mu$  U. andropogonis\* (b)
3. Teliospores double celled; urediospores  $18-20 \times 19-22 \mu$  . . . . . P. ellisiana (c)
4. Teliospores  $19-27 \times 30-40 \mu$ ; urediospores  $26-31 \times 26-33 \mu$ ; Group V . . . . . P. tripsaci (d)
4. Teliospores  $16-21 \times 30-44 \mu$ ; urediospores  $20-23 \times 21-25 \mu$ ; Groups V, VI . . . . . P. andropogonis (e)



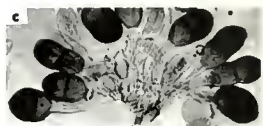
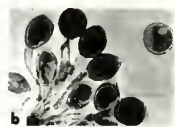
## Anthoxanthum

1. Telia naked; Group V . . . . . P. graminis (a)
1. Telia covered; Groups II, VI . . . . .
2. Group II, . . . . . P. poae-nemoralis (b)
2. Group VI . . . . . P. recondita (c)



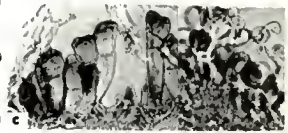
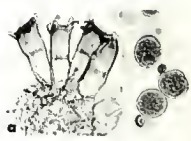
Aristida

1. Group VIII . . . . . 2
1. Group V; urediospores  $13-23 \times 23-40 \mu$ ;  
teliospore pedicel  $50 \mu$  . P. graminis (a)
2. Teliospores single celled; uredio-  
spores  $16-23 \times 18-25 \mu$ , sidewall  
 $2.5-3 \mu$  . . . . . U. peckianus (b)
2. Teliospores double celled; uredio-  
spores  $18-24 \times 19-33 \mu$  (pores can  
also be equatorial), sidewall  
 $3-5 \mu$  . . . . . P. aristidae (c)



Arrhenantherum

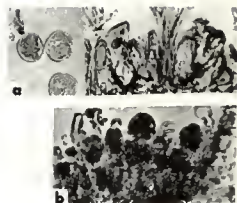
1. Teliospores coronate, telia covered or  
naked; urediospores  $13-26 \times 14-36 \mu$ ;  
Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group II . . . . . 3
2. Groups V, VI . . . . . 4
3. Urediospores  $19-26 \times 21-32 \mu$  . . . . .  
. . . . . P. montanensis (b)
3. Urediospores  $17-24 \times 22-29 \mu$  . . . . .  
. . . . . P. poae-nemoralis (c)
4. Telia covered; urediospores  $14-32$   
 $\times 16-18 \mu$ ; Group VI P. recondita (d)
4. Telia naked; urediospores  $13-23 \times$   
 $23-40 \mu$ ; Group V P. graminis (e)





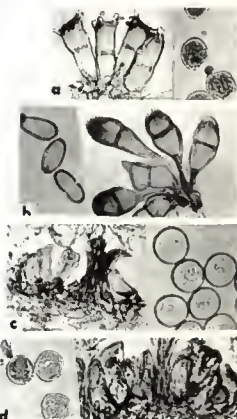
## Arundo

1. Telia covered; Group VI - . P. recondita (a)  
 1. Telia naked; Group II . . . P. magnusiiana\* (b)



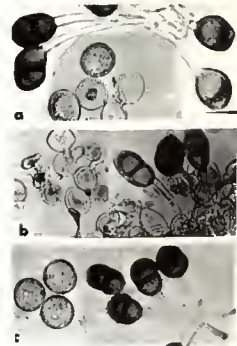
## Avena

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. coronata (a)  
 1. Teliospores not coronate . . . . . 2  
     2. Group V; telia naked . . . . . P. graminis (b)  
     2. Group VI; telia covered . . . . . 3  
 3. Sori in lines; urediospores  $19-26 \times 19-30 \mu$  . . . . . P. striiformis (c)  
 3. Sori scattered; urediospores  $14-32 \times 16-18 \mu$  . . . . . P. recondita (d)



## Bouteloua

1. Amphispores predominate; Group VI . . . . . P. vexans (a)  
 1. Amphispores absent or rare . . . . . 2  
     2. Group V; teliospores  $19-25 \times 29-36 \mu$  . . . . . P. cabata (b)  
     2. Group VI . . . . . 3  
 3. Teliospores  $16-25 \times 26-40 \mu$  . . . . . P. chlorides (c)  
 3. Teliospores  $18-24 \times 23-30 \mu$  . . . . . P. boutelouae (d)





## Brachyelytrum

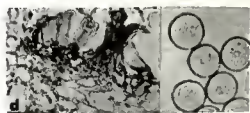
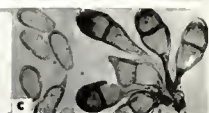
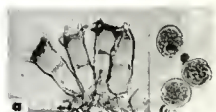
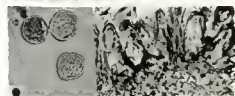
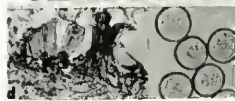
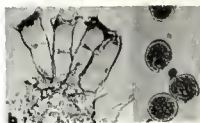
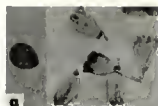
Teliospores single celled, coronate; Group  
I . . . . . U. halstedii

## Briza

1. Teliospores coronate; telia covered or  
naked; urediospores 13-26 x 14-36  $\mu$ ;  
Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group V; telia naked . . . . .  
. . . . . P. graminis (b)
2. Group VI; telia covered . . . . . 3
3. Sori in lines; urediospores 19-26 x  
19-30  $\mu$  . . . . . P. striiformis (c)
3. Sori scattered; urediospores 14-32 x  
16-18  $\mu$  . . . . . P. recondita (d)

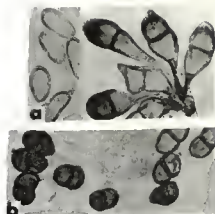
## Bromus

1. Teliospores coronate; telia covered or  
naked; urediospores 13-26 x 14-36  $\mu$ ;  
Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group II; teliospores 18-34 x  
35-64  $\mu$  . . . . . P. montanensis (b)
2. Groups V, VI . . . . . 3
3. Group V; telia naked . . . . . P. graminis (c)
3. Group VI; telia covered . . . . . 4
4. Sori in lines; urediospores 19-26  
x 19-30  $\mu$  . . . . . P. striiformis (d)
4. Sori scattered; urediospores 14-32  
x 16-18  $\mu$  . . . . . P. recondita (e)



## Buchloes

1. Group V; teliospores  $16-23 \times 34-55 \mu$   
 . . . . . P. graminis (a)
1. Group VI; teliospores  $16-19 \times 24-32 \mu$   
 . . . . . P. kansensis (b)



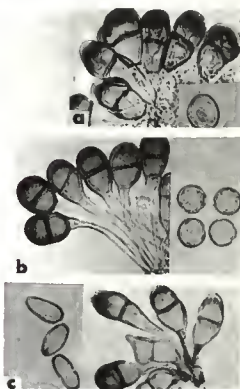
## Calamagrostis

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ;  
 Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Groups II, V . . . . . 3
2. Group VI . . . . . 4
3. Group V; telia naked . . . . P. graminis (b)
3. Group II; telia covered . . . . . (c)
- . . . . . P. poae-nemorialis
4. Sori in lines; urediospores  $19-26 \times 19-30 \mu$  . . . . . P. striiformis (d)
4. Sori scattered; urediospores  $14-32 \times 16-18 \mu$  . . . . . P. recondita (e)



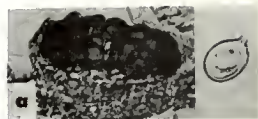
## Calamovifa

1. Group VI; teliospores  $18-30 \times 30-55 \mu$   
 . . . . . P. amphigena (a)
1. Group V . . . . . 2
2. Urediospores  $25-31 \times 23-30 \mu$ , pores basal . . . . . P. sporoboli (b)
2. Urediospores  $13-23 \times 23-40 \mu$ , pores equatorial . . . . . P. graminis (c)



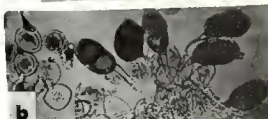
## Cenchrus

1. Group V; urediospores  $23-32 \times 30-44 \mu$ ;  
teliospores  $19-26 \times 40-54 \mu$  P. cenchri (a)



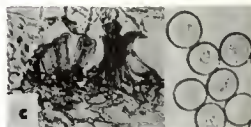
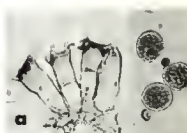
## Chloris

1. Telia covered; sori in lines; urediospores  $19-26 \times 19-30 \mu$ ; Group VI . . . . .  
. . . . . P. striiformis (a)
1. Telia naked . . . . . 2
2. Group VI; urediospores  $18-22 \times 16-23 \mu$ ; teliospores  $16-25 \times 26-40 \mu$  . . . . . P. chlorides (b)
2. Group V . . . . . 3
3. Urediospores  $19-23 \times 26-29 \mu$ ; teliospore pedicel approx.  $115 \mu$  . . . . . P. cabata (c)
3. Urediospores  $16-23 \times 34-55 \mu$ ; teliospore pedicel approx.  $50 \mu$  . . . . . P. graminis (d)



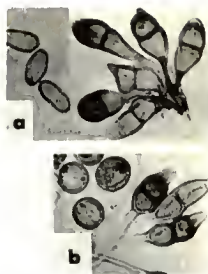
## Cinna

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ;  
Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group V; telia naked P. graminis (b)
2. Group VI; telia covered . . . . . 3
3. Sori in lines; urediospores  $19-26 \times 19-30 \mu$  . . . . . P. striiformis (c)
3. Sori scattered; urediospores  $14-32 \times 16-18 \mu$  . . . . . P. recondita (d)



## Cynodon

1. Group V; urediospores  $13-23 \times 23-40 \mu$ ;  
teliospores  $16-23 \times 34-55 \mu$  . . . . . P. graminis (a)
1. Group VII; urediospores  $19-23 \times 20-26$   
 $\mu$ ; teliospores  $16-22 \times 30-55 \mu$  . . . . . P. cynodontis (b)



## Cynosurus

1. Teliospores coronate; tella covered or  
naked; urediospores  $13-26 \times 14-36 \mu$ ;  
Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group V; teliospores two celled  
. . . . . P. graminis (b)
2. Group VI; teliospores single celled  
. . . . . U. dactylidis (c)



## Danthonia

1. Urediospores  $13-23 \times 23-40 \mu$ ; teliospores  
 $16-23 \times 34-55 \mu$ ; Group V . . . . . P. graminis (a)

## Diaharrena

1. Urediospores  $13-23 \times 23-40 \mu$ ; teliospores  
 $16-23 \times 34-55 \mu$ ; Group V . . . . . P. graminis (a)



## Digitaria

1. Teliospores diorchidioid; urediospores  
 $19-26 \times 23-30 \mu$ ; Group V . . . . . P. levis

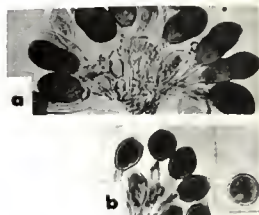
## Dactylis

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group V; telia naked. P. graminis (b)
2. Group VI; telia covered . . . . . 3
3. Teliospores single celled; urediospores  $14-25 \times 17-29 \mu$  . . . . . U. dactylidis (c)
3. Teliospores two celled . . . . . 4
4. Sori in lines; urediospores  $19-26 \times 19-30 \mu$  . P. striiformis (d)
4. Sori scattered; urediospores  $14-32 \times 16-18 \mu$  . P. recondita (e)



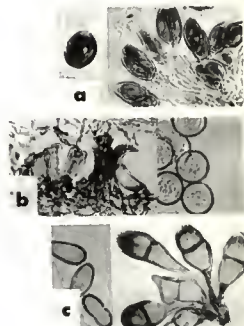
## Distichis

1. Teliospores two celled; urediospores  $18-24 \times 19-33 \mu$ ; Group VIII . . . . . P. aristidae (a)
1. Teliospores single celled; urediospores  $16-23 \times 18-25 \mu$ ; Group VIII . . . . . U. peckianus (b)



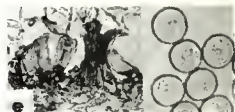
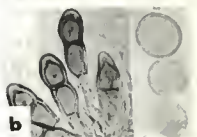
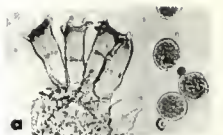
## Echinochoa

1. Teliospores diorchidioid; urediospores  $18-25 \times 23-29 \mu$ ; Group VI . . . . . P. abnormis (a)
1. Teliospores normal . . . . . 2
2. Group VI; sori in lines . . . . . P. striiformis (b)
2. Group V; sori scattered . . . . . P. graminis (c)



## Elymus

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36$ ;  
Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
  2. Telia naked . . . . . 3
  2. Telia covered . . . . . 4
3. Group VI; teliospores  $16-23 \times 29-37 \mu$   
striate . . . . . P. pattersoniana (b)
3. Group V; teliospores  $16-23 \times 34-55 \mu$ ,  
not striate . . . . . P. graminis (c)
4. Group II, teliospores  $18-34 \times$   
 $35-64 \mu$  . . . . . P. montanensis (d)
4. Groups VI, V . . . . . 5
5. Sori in lines, urediospores  $19-26 \times$   
 $19-30 \mu$  . . . . . P. striiformis (e)
5. Sori scattered, urediospores  $14-32 \times$   
 $16-18 \mu$  . . . . . P. recondita (f)



## Eragrostis

1. Teliospores single-celled; urediospores  
 $16-20 \times 20-26 \mu$ ; Group VI . . . . .  
. . . . . P. eragrostidis (a)



## Erianthus

1. Urediospores  $20-27 \times 31-40 \mu$ ; telio-  
spores  $18-26 \times 45-60 \mu$ ; Group I . . . . .  
. . . . . P. virgata (a)



## Euchlaena

1. Telia naked; urediospores  $23-28 \times$   
 $26-30 \mu$ ; Group V . . . . . P. sorghi (a)



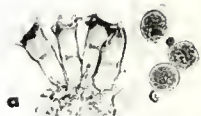


1. Telia covered; urediospores  $23-29 \times 29-36 \mu$ ; teliospores angular and brittle  
 . . . . . P. polysora (b)



# Festuca

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. coronata (a)



1. Teliospores not coronate . . . . . 2

2. Telia naked . . . . . 3

2. Telia covered . . . . . 4



3. Group V; urediospores  $13-23 \times 23-40 \mu$  . . . . . P. graminis (b)

3. Group VI; urediospores  $23-27 \times 29-35 \mu$  . . . . . P. crandallii\* (c)

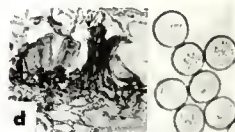


4. Sori in lines, urediospores  $19-26 \times 19-30 \mu$ ; Group VI . . . . . P. striiformis (d)

4. Sori scattered . . . . . 5

5. Group II . . . . . 6

5. Group VI . . . . . 7



6. Urediospores cinnamon,  $19-29 \times 21-33 \mu$  . . . . . P. pygmaea (e)

6. Urediospores hyaline to yellow,  $17-24 \times 22-29 \mu$  E. passerinervis (f)



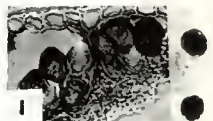
7. Teliospores single-celled . . . . . 8

7. Teliospores double-celled . . . . . 10

8. Teliospores angular . . . . . 9

8. Teliospores rounded; urediospores  $14-25 \times 17-29 \mu$  . . U. dactylidis (g)

9. Telia pulverulent, paraphyses absent . . . . . U. mysticus (h)



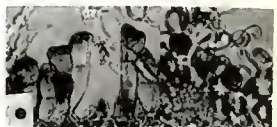
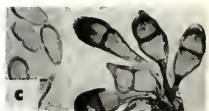
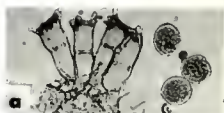
9. Telia remain covered, paraphyses present especially on sheaths . . U. hordeinus (i)

10. Teliospores prominetely angular and squared . . . . . 11
10. Teliospores mostly rounded . . . . . 12
11. Telia with paraphyses; urediospores 15-18 x 21-26  $\mu$  . . . . . P. piperi (j)
11. Telia without paraphyses, urediospores 18-24 x 23-30  $\mu$  . . . . . P. sessilis (k)
12. Teliospores 10-15 x 32-85  $\mu$ ; urediospores 11-32 x 16-18  $\mu$  . . . . . P. recondita (l)
12. Teliospores 15-23 x 35-55  $\mu$ ; urediospores 16-24 x 19-29  $\mu$  . . . . . P. poarum (m)



# Glyceria

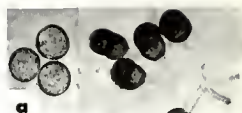
1. Teliospores coronate; telia covered or naked; urediospores 13-26 x 14-36  $\mu$ ; Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Telia naked . . . . . 3
2. Telia covered . . . . . 4
3. Teliospores single celled; Group VI . . . . . U. amphydinus (b)
3. Teliospores double-celled; Group V . . . . . P. graminis (c)
4. Teliospores 10-25 x 32-85  $\mu$ ; Group VI . . . . . P. recondita (d)
4. Teliospores 14-20 x 36-50  $\mu$ ; Group II . . . . . P. rosea-demoralis (e)





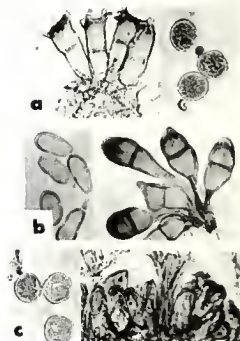
## Gymnopogon

1. Urediospores  $18-25 \times 21-29 \mu$ ; teliospores  $18-24 \times 23-30 \mu$ ; Group VI . . . . .  
 . . . . . P. *boutelouae* (a)



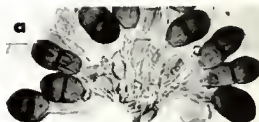
## Hierochloa

1. Teliospores coronate, telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. *coronata* (a)  
 1. Teliospores not coronate . . . . . 2  
     2. Group V; telia naked . . P. *graminis* (b)  
     2. Group VI; telia covered . . . . . P. *recondita* (c)



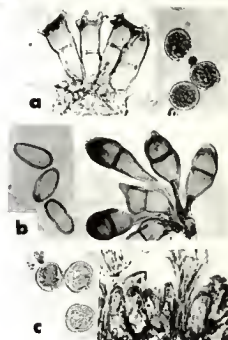
## Hilaria

1. Urediospores  $18-24 \times 19-33 \mu$ ; teliospores  $18-29 \times 30-50$ ; Group VIII; pores also equatorial . . . . . P. *aristidae*



## Holcus

1. Teliospores coronate, telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. *coronata* (a)  
 1. Teliospores not coronate . . . . . 2  
     2. Group V; telia naked . . P. *graminis* (b)  
     2. Group VI; telia covered . . . . . P. *recondita* (c)

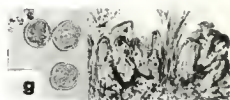
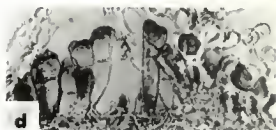
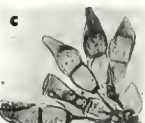
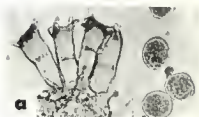


1. Telia naked . . . . . 2
2. Group V; teliospores  $16-21 \times 45-64$ ,  
pedicel  $200 \mu$  . . . . . P. phragmites (b)
2. Group II; teliospores  $18-19 \times 26-42$ , pedicel  $50 \mu$  . . . . . P. magusiana\* (c)



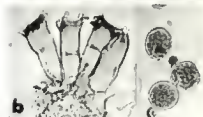
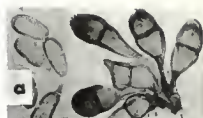
# Poa

1. Teliospores coronate; telia covered or  
naked; urediospores  $13-26 \times 14-36 \mu$ ;  
Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Telia naked . . . . . 3
2. Telia covered . . . . . 4
3. Group V; urediospores  $13-23 \times 23-40 \mu$   
. . . . . P. graminis (b)
3. Group VI; urediospores  $23-27 \times 29-35 \mu$   
. . . . . P. crandallii\* (c)
4. Group II . . . . . 5
4. Group VI . . . . . 6
5. Urediospores  $17-24 \times 22-29 \mu$  . . . . .  
. . . . . P. poae-nemoralis (d)
5. Urediospores  $19-26 \times 21-32 \mu$  . . . . .  
. . . . . P. montanensis (e)
6. Teliospores single-celled . . . . .  
. . . . . U. dactylidis (f)
6. Teliospores double-celled . . . . . 7
7. Urediospores  $14-32 \times 16-48 \mu$ , yellow to  
cinnamon . . . . . P. recondita (g)
7. Urediospores  $16-24 \times 19-29 \mu$ , hyaline to  
yellow . . . . . P. poarum (h)



## Polypogon

1. Groups II, VI . . . . . 2
1. Group V; teliospores  $16-23 \times 34-55 \mu$ ,  
not coronate . . . . . *P. graminis* (a)
2. Teliospores coronate; urediospores  
 $13-26 \times 14-36 \mu$  Groups II, VI . .  
. . . . . *P. coronata* (b)
2. Teliospores not coronate; uredio-  
spores  $14-32 \times 16-48 \mu$  Group VI .  
. . . . . *P. recondita* (c)



## Puccinella

1. Group VI . . . . . 2
1. Group II, V . . . . . 4
2. Teliospores single celled, uredio-  
spores  $14-25 \times 17-29 \mu$  . . . . .  
. . . . . *U. dactylidis* (a)
2. Teliospores double celled . . . . . 3
3. Sori in lines; urediospores  $19-26 \times 19-30 \mu$  . . . . . *P. striiformis* (b)
3. Sori scattered; urediospores  $14-32 \times 16-48 \mu$  . . . . . *P. recondita* (c)
4. Group II; telia covered . . . . .  
. . . . . *P. poae-nemorialis* (d)
4. Group V; telia naked . *P. graminis* (e)



## Redfieldia

1. Group VII; teliospores  $21-26 \times 33-50 \mu$   
. . . . . *P. redfieldiae* (a)



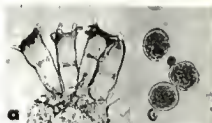
Schedonnardus

1. Group VI; teliospores 16-25 x 27-42  $\mu$   
 . . . . . *P. schedonnardi* (a)



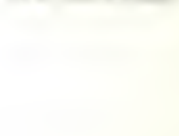
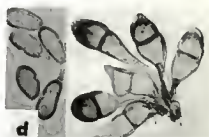
Secale

1. Teliospores coronate; telia covered or  
 naked; urediospores 13-26 x 14-36  $\mu$ ;  
 Groups II, VI . . . . . *P. coronata* (a)
1. Teliospores not coronate . . . . . 2
  2. Group V; telia naked . *P. graminis* (b)
  2. Group VI; telia covered . . . . . 3
3. Sori in lines; urediospores 19-26 x 19-  
 30  $\mu$  . . . . . *P. striiformis* (c)
3. Sori scattered; urediospores 14-32 x 16-  
 18  $\mu$  . . . . . *P. recondita* (d)



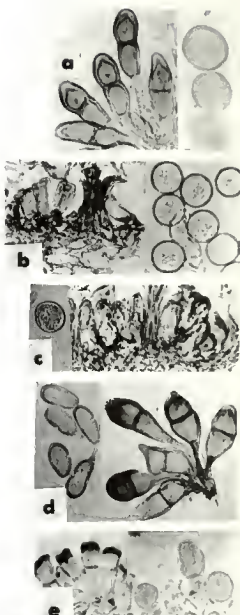
Setaria

1. Teliospores diorchidioid; urediospores  
 19-26 x 23-30  $\mu$ ; Group V . . . *P. levis* (a)
1. Teliospores with normal septation . . . 2
  2. Group VII; teliospores 22-29 x 30-  
 41  $\mu$ ; pedicel 120  $\mu$  . *P. esclavensis* (b)
  2. Group V; pedicel 30-50  $\mu$  . . . . . 3
3. Teliospores angular, brittle; not apically  
 thickened . . . . . *P. polysora* (c)
3. Teliospores rounded and apically thick-  
 ened . . . . . 4
  4. Urediospores oblong . *P. graminis* (d)
  4. Urediospores ovoid to ellipsoid . .  
 . . . . . *P. substriata* (e)



# Sitanion

1. Group VI . . . . . 2
1. Groups II, V . . . . . 4
  2. Telia covered . . . . . 3
  2. Telia naked; urediospores 17-23 x 20-28  $\mu$  . . . . . P. pattersoniana (a)
3. Sori in lines; urediospores 19-26 x 19-30  $\mu$  . . . . . P. striiformis (b)
3. Sori scattered; urediospores 14-32 x 16-48  $\mu$  . . . . . P. recondita (c)
4. Group V; telia naked . P. graminis (d)
4. Group II; telia covered . . . . . P. montanensis (e)



# Sorghastrum

1. Group I; teliospores 18-26 x 45-60  $\mu$  . . . . . P. virgata (a)



# Sorghum

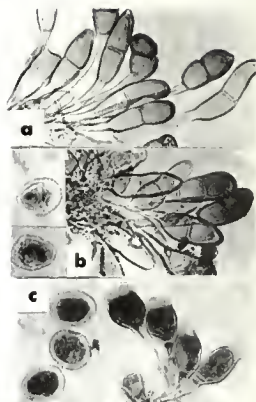
1. Group II; teliospores double celled . . . . . P. purpurea (a)
1. Group VII; teliospores single celled . . . . . U. andropogonis\* (b)



# Spartina

1. Urediospores apically thickened . . . . . 2
1. Urediospores uniformly thickened . . . . . 3

2. Urediospore apex 9-29  $\mu$ , teliospore pedicel 150  $\mu$  . . . P. seymouriana (a)
2. Urediospore apex 7-10  $\mu$ ; teliospore pedicel 100  $\mu$  . . . P. sparganioides (b)
3. Teliospore single-celled . . . . . U. accuminatus (c)
3. Teliospore double-celled . . . . . P. distichidis (d)



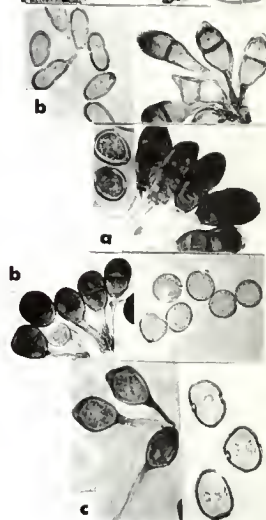
#### Sphenophilis

1. Group VI; telia covered . . . P. eatoniae (a)
1. Group V; telia naked . . . P. graminis (b)



#### Sporobolus

1. Group V . . . . . 3
1. Group VI . . . . . 2
2. Teliospore 23-33 x 40-60  $\mu$ , apex 5-12  $\mu$  . . . . . P. luxuriosa (a)
2. Teliospore 16-25 x 27-42  $\mu$ , apex 3-7  $\mu$  . . . . . P. schedonnardi (b)
3. Teliospores single-celled; urediospore 23-30 x 29-40  $\mu$  . . . . . U. sporoboli (c)
3. Teliospores double-celled . . . . . 4
4. Teliospore pedicel 90 or more . . . 5
4. Teliospore pedicel 70 or less . . . 6
5. Urediospores with thickened apex . . . . . P. vilfae (d)



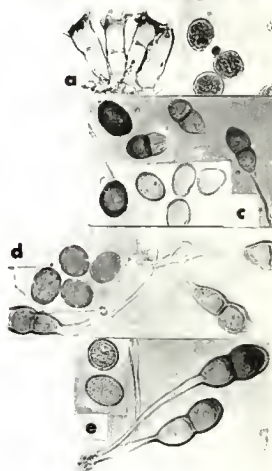


5. Urediospores uniformly thickened . . .  
 . . . . . P. cryptandrius (e)
6. Urediospores with pores basal . . .  
 . . . . . P. sporoboli (f)
6. Urediospores with equatorial pores  
 . . . . . P. graminis (g)



### Stipa

1. Teliospores coronate; telia covered or naked, urediospores  $13-26 \times 14-36 \mu$ ; Group II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group IX; teliospore pedicel  $200 \mu$ , apical wall  $6-18 \mu$  P. interveniens (b)
2. Groups V, VI, VII. . . . . 3
3. Group VI . . . . . 4
3. Groups V, VII . . . . . 6
4. Amphispores present, teliospores  $16-22 \times 36-46 \mu$  . . . P. substerilis (c)
4. Amphispores absent . . . . . 5
5. Urediospores  $19-27 \times 24-31 \mu$ ; teliospores  $14-24 \times 34-55 \mu$ , pedicel  $100 \mu$  . . . . . P. monica (d)
5. Urediospores  $18-23 \times 21-26 \mu$ ; teliospores  $18-25 \times 35-64 \mu$ , pedicel  $165 \mu$  P. stipae\* (e)
6. Group V; teliospores  $16-23 \times 34-55 \mu$  . . . . . P. graminis (f)
6. Group VII; teliospores  $16-23 \times 29-43 \mu$  . . . . . P. windsoriae (g)



### Triodia

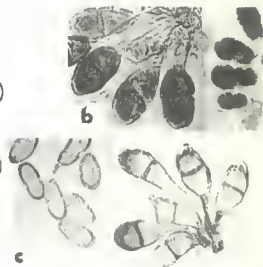
1. Group VII; teliospore  $16-23 \times 29-43 \mu$  . . . . . P. windsoriae (a)



1. Group V . . . . . 2

2. Urediospores ellipsoid 18-26 x 26-40  $\mu$ ; teliospores pedicel 100  $\mu$  . . . . . P. cryptandrus (b)

2. Urediospores oblong 13-23 x 23-40  $\mu$ ; teliospores pedicel 50  $\mu$  . . . . . P. graminis (c)



### Triplasis

1. Group VII; teliospore 16-23 x 29-43  $\mu$ , pedicel 70  $\mu$  . . . . . P. windsoriae (a)

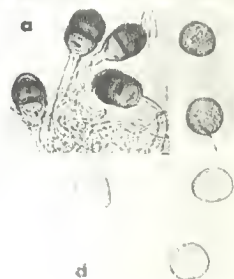
1. Group VI; teliospore 16-25 x 27-42  $\mu$ , pedicel 130  $\mu$  . . . . . P. schedonnardi (b)



### Tripsacum

1. Telia naked; urediospores 26-31 x 26-33  $\mu$  . . . . . P. tripsaci (a)

1. Telia covered; urediospores 23-29 x 29-36  $\mu$  . . . . . P. polysora (b)



### Trisetum

1. Teliospores coronate; telia covered or naked, urediospores 13-26 x 14-36  $\mu$ ; Groups II, VI . . . . . P. coronata (a)

1. Teliospores not coronate . . . . . 2

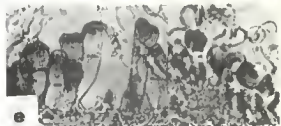
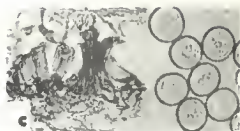
2. Group VI . . . . . 3

2. Groups II, V . . . . . 6





3. Teliospores single-celled, urediospores 14-25 x 17-29 . . . . . U. dactylidis (b)  
 3. Teliospores double-celled . . . . . 4  
     4. Telia naked; urediospores 19-27 x 24-31  $\mu$   
     4. Telia covered . . . . . 5  
 5. Sori in lines; urediospores 19-26 x 29-30  $\mu$  . . . . . P. striiformis (c)  
 5. Sori scattered; urediospores 14-32 x 16-48  $\mu$  . . . . . P. recondita (d)  
     6. Group II; telia covered . . . . .  
        . . . . . P. poae-nemorialis (e)  
     6. Group V; telia naked . P. graminis (f)



#### Triticum

1. Telia naked; Group V . . . . . P. graminis (a)  
 1. Telia covered; Group VI . . . . . 2  
     2. Sori in lines; urediospores 19-26 x 19-30  $\mu$  . . . . . P. striiformis (b)  
     2. Sori scattered; urediospores 14-32 x 16-48  $\mu$  . . . . . P. recondita (c)



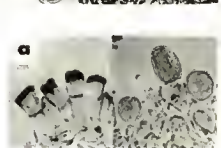
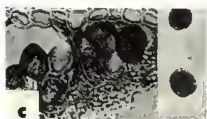
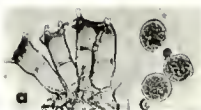
#### Zea

1. Telia covered; urediospores 23-29 x 29-36  $\mu$  . . . . . P. polysora (a)  
 1. Telia naked; urediospores 23-28 x 26-30  $\mu$  . . . . . P. sorghi (b)



## Hordeum

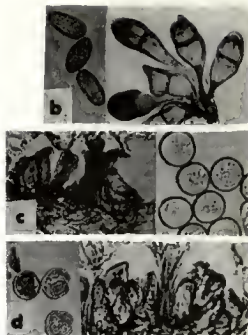
1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
  2. Teliospores single-celled . . . 3
  2. Teliospores double-celled . . . 4
3. Telia covered but pulverulent; paraphyses absent; Group VI . U. mysticus (b)
3. Telia remaining covered, paraphyses present especially on host sheath . . . . . U. hordeinus (c)
  4. Group II . . . . . 5
  4. Group V, VI . . . . . 7
5. Urediospores hyaline to yellow,  $17-24 \times 22-29 \mu$ ; paraphyses clavate to capitate . . . . . P. poae-nemorialis (d)
5. Urediospores yellow to cinnamon . . . 6
  6. Paraphyses clavate; teliospores  $13-34 \times 35-64 \mu$  . P. montanensis (e)
  6. Paraphyses capitate; teliospores  $12-20 \times 30-50 \mu$  . . . P. pygmaea (f)
7. Group V; teliospores  $16-23 \times 34-55 \mu$  . . . . . P. graminis (g)
7. Group VI . . . . . 8
  8. Sori in lines; urediospores  $19-26 \times 19-30 \mu$  . . . . P. striiformis (h)
  8. Sori scattered . . . . . 9
9. Mesospores numerous; urediospores  $16-24 \times 22-29 \mu$  . . . . . P. hordei (i)
9. Mesospores not present; urediospores  $14-32 \times 16-48 \mu$  . . . . . P. recondita (j)



## Hystrix

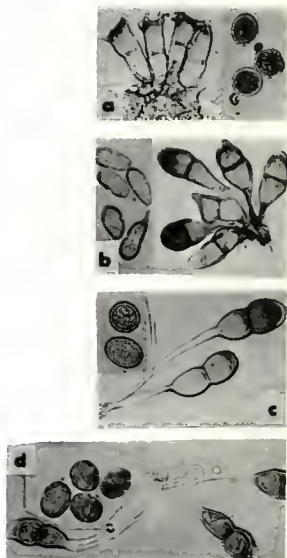
1. Group II, teliospores  $18-34 \times 35-64 \mu$  . . . . . P. montanensis (a)

1. Groups V, VI . . . . . 2
  2. Group V, telia naked *P. graminis* (b)
  2. Group VI, telia covered . . . . . 3
3. Sori in lines, urediospores 19-26 x 19-30  $\mu$  . . . . . *P. striliformis* (c)
3. Sori scattered, urediospores 14-32 x 16-18  $\mu$  . . . . . *P. recondita* (d)



### Koeleria

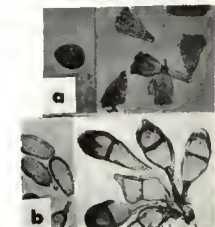
1. Teliospores coronate; telia naked or covered; urediospores 13-26 x 14-36  $\mu$ ; Groups II, VI . . . . . *P. coronata* (a)
1. Teliospores not coronate . . . . . 2
  2. Telia naked . . . . . 3
  2. Telia covered . . . . . 5
3. Group V, teliospores 16-23 x 34-55  $\mu$  . . . . . *P. graminis* (b)
3. Group VI . . . . . 4
  4. Teliospores 18-25 x 35-64  $\mu$ ; pedicel 165  $\mu$ ; urediospores 18-23 x 21-26  $\mu$  . . . . . *P. stipae\** (c)
  4. Teliospores 14-24 x 34-55  $\mu$ ; pedicel 100  $\mu$ ; urediospores 19-27 x 24-31 . . . . . *P. monoica* (d)
5. Group II; teliospores 13-21 x 40-60  $\mu$  . . . . . *P. koeleriae* (e)
5. Group VI . . . . . 6
  6. Teliospores angular to sometimes rounded . . . . . 7
  6. Teliospores rounded and never angular . . . . . 8
7. Teliospores 16-29 x 42-55  $\mu$ , apical wall 4-7  $\mu$ ; urediospores 18-23 x 23-30  $\mu$  . . . . . *P. liatridis\** (f)
7. Teliospores 18-26 x 28-45  $\mu$ , apical wall 3-5  $\mu$ ; urediospores 14-19 x 24-36  $\mu$  . . . . . *P. conspicua* (g)



8. Sori in lines; urediospores 19-26  
x 19-30  $\mu$  . . . P. striformis (h)
8. Sori scattered; urediospores 14-  
32 x 16-48  $\mu$  . . . . P. recondita (i)

### Leersia

1. Teliospores coronate, single-celled;  
urediospores 16-21 x 22-28  $\mu$ ; Group  
I . . . . . U. balstedii (a)
1. Teliospores not coronate . . . . . 2
2. Group V, telia naked P. graminis (b)
2. Group VI, telia covered . . . . .  
. . . . . P. recondita (c)



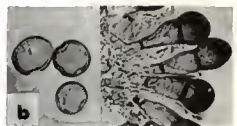
### Leptochloa

1. Group VI; teliospores 16-25 x 26-40  $\mu$   
. . . . . P. chloridis
1. Group VIII; teliospores 17-24 x 25-  
34  $\mu$  . . . . . P. leptochloae



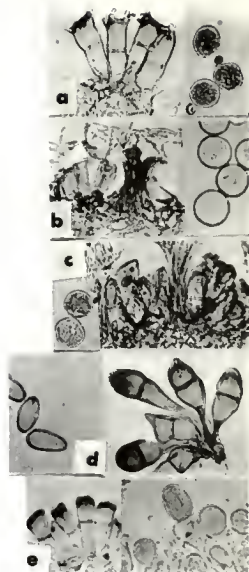
### Leptoloma

1. Group VI; teliospores single-celled  
. . . . . U. graminicole (a)
1. Groups V, VII . . . . . 2
2. Group V; teliospore pedicel 15 $\mu$   
. . . . . P. imposita (b)
2. Group VII; teliospore pedicel  
120  $\mu$  . . . . . P. esclavensis (c)



## Lolium

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ , Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
  2. Group VI . . . . . 3
  2. Group II, V . . . . . 4
3. Sori in lines; urediospores  $13-24 \times 32-36 \mu$  . . . . . P. striiformis (b)
3. Sori scattered; urediospores  $14-32 \times 16-48 \mu$  . . . . . P. recondita (c)
4. Group V, telia naked P. graminis (d)
4. Group II, telia covered . . . . . P. mutabilis (e)



## Medica

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ , Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
  2. Telia covered . . . . . 3
  2. Telia naked . . . . . 5
3. Group VI; teliospores  $10-25 \times 32-85 \mu$  . . . . . P. recondita (b)
3. Group II . . . . . 4
  4. Urediospores hyaline-yellow,  $17-24 \times 22-29 \mu$  . . . . . P. poae-nemorialis (c)
  4. Urediospores cinnamon,  $19-29 \times 21-33 \mu$  . . . . . P. pygmaea (d)
5. Group VI; teliospores  $16-25 \times 27-42 \mu$  . . . . . P. schedonnardi (e)
5. Groups II, V . . . . . 6



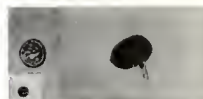
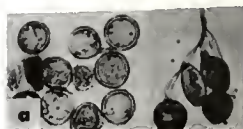
6. Group II; teliospores  $20-26 \times 32-40$   
 $\mu$ , verrucose . . . . . P. paradoxica (f)
6. Group V; teliospores  $16-23 \times 34-55$   
 $\mu$  . . . . . P. graminis (g)

# Muhlenbergia

1. Teliospores single-celled . . . . . 2
1. Teliospores double-celled . . . . . 4
2. Group V; teliospores  $20-23 \times 23-27$   $\mu$  . . . . . U. major (a)
2. Group VI . . . . . 3
3. Urediospores  $13-17 \times 15-20$   $\mu$ ; teliospores  $12-17 \times 14-23$   $\mu$ , pedicel  $30$   $\mu$  . . . . . U. minimus (b)
3. Urediospores  $21-25 \times 24-30$   $\mu$ ; teliospores  $16-24 \times 24-31$   $\mu$ , pedicel  $100$   $\mu$  . . . . . U. epicampes (c)
4. Group V, teliospores  $16-23 \times 34-55$   $\mu$  . . . . . P. graminis (d)
4. Group VI . . . . . 5
5. Teliospores normal to diorchidioid; urediospores  $12-18 \times 19-24$   $\mu$  . . . . . P. dochmia (e)
5. Teliospores normal with very rare diorchidioid nature . . . . . 6
6. Teliospores  $16-25 \times 27-42$ , apical wall  $3-7$   $\mu$ ; urediospores  $18-26 \times 19-28$   $\mu$  . . . . . P. schedonnardi (f)
6. Teliospores  $23-33 \times 40-60$   $\mu$ , apical wall  $5-12$   $\mu$ , urediospores  $20-25 \times 26-32$   $\mu$  . . . . . P. luxuriosa (g)

# Oryza

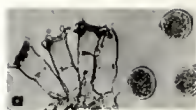
1. Group V, teliospores  $16-23 \times 34-55$   $\mu$  . . . . . P. graminis (a)





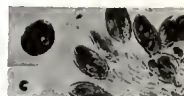
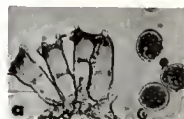
## Oryzopsis

1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
  2. Group VI . . . . . 3
  2. Groups V, II . . . . . 5
3. Amphispores formed, teliospores  $16-22 \times 36-46 \mu$  . . . . . P. substerilis (b)
3. Amphispores absent . . . . . 4
  4. Teliospores  $18-25 \times 35-64 \mu$ , pedicel  $165 \mu$  . . . . . P. stipae\* (c)
  4. Teliospores  $18-26 \times 30-50 \mu$ , pedicel  $70 \mu$  . . . . . P. micrantha (d)
5. Group V, telia naked . . . . . P. burnetti (e)
5. Group II, telia covered . . . . . P. pygmaea (f)



## Panicum

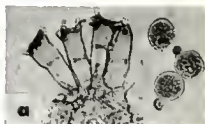
1. Teliospores coronate; telia covered or naked; urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
  2. Teliospores diorchidoid . . . . . 3
  2. Teliospores normal . . . . .
3. Group V; teliospore pedicel  $200 \mu$  . . . . . P. levis (b)
3. Group VI; teliospore pedicel  $50 \mu$  . . . . . P. abnormis (c)



4. Groups VI and VII . . . . . 7
4. Group V . . . . . 5
5. Urediospores oblong; teliospores 16-23  
x 34-55  $\mu$  . . . . . P. graminis (d)
5. Urediospores broadly ellipsoid . . . . . 6
6. Urediospores 23-30 x 28-36  $\mu$ ; telio-  
spores 19-26 x 33-50  $\mu$  . . . . .  
. . . . . P. substriata (e)
6. Urediospores and teliospores never  
as large as above; (very similar  
morphological). . . . . P. panicl (f)  
characters) . . . . . P. emaculata (g)
7. Group VI; teliospores single-celled  
. . . . . U. graminicola (h)
7. Group VII, teliospores double-celled  
. . . . . P. esclavensis (i)

# Paspalum

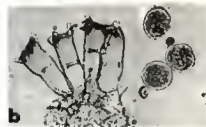
1. Teliospores coronate; telia covered or  
naked; urediospores 13-26 x 14-36  $\mu$ ;  
Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group VII; teliospores 22-29 x  
30-41  $\mu$  . . . . . P. esclavensis (b)
2. Group V . . . . . 3
3. Teliospores diorchidioid; urediospores  
19-26 x 23-30  $\mu$  . . . . . P. levis (c)
3. Teliospores with normal septation . . . . . 4
4. Urediospores 23-30 x 28-36  $\mu$ ;  
teliospores 19-26 x 33-50  $\mu$  . . . . .  
. . . . . P. substriata (d)
4. Urediospores 18-23 x 21-26  $\mu$ ;  
teliospores 16-23 x 30-44  $\mu$  . . . . .  
. . . . . P. emaculata (e)





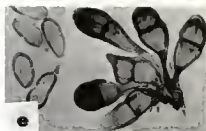
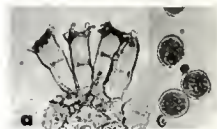
## Phlaris

1. Group V; teliospores  $16-23 \times 34-55 \mu$  . . . . . P. graminis (a)
1. Groups II, VI . . . . . 2
2. Teliospores coronate; urediospores  $13-26 \times 14-36$  . . . . . P. coronata (b)
2. Teliospores not coronate; urediospores  $18-24 \times 23-30 \mu$  . P. sessilis (c)



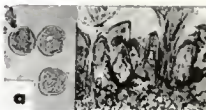
## Phleum

1. Teliospores coronate; telia naked or covered, urediospores  $13-26 \times 14-36 \mu$ ; Groups II, VI . . . . . P. coronata (a)
1. Teliospores not coronate . . . . . 2
2. Group VI . . . . . 3
2. Groups II, V . . . . . 4
3. Teliospores single celled . U. dactylidis (b)
3. Teliospores double celled . . . P. poae (c)
4. Group II; telia covered . . . . . P. poae-nemorialis (d)
4. Group V; telia naked . . P. graminis (e)



## Phragmites

1. Telia covered; urediospores  $14-32 \times 16-48 \mu$ ; Group VI . . . . . P. recondita (a)



PUCCINIA Pers.

Synopsis Methodica Fungorum, p. 225. 1801.

Type species: Puccinia graminis Pers.

A heterothallic fungus typically completing it's life cycle on two hosts. However, only those that occur on grasses, the uredial and telcal stages, will be discussed in this treatment.

Uredia covered or naked, paraphyses present or not; urediospores single celled, hyaline, yellow to cinnamon, echinulate, verrucose to smooth, pores one to 10, scattered or equatorial; usually born on pedicels but may be single. Telia covered or erumpant to naked; paraphyses may be present or not; teliospores two celled; smooth; cinnamon to chestnut, pedicels present.

1. Puccinia abnorminis P. Hen. Hedw. 35:243, 1876. (Plate VIII, Fig. 1).

Syn: Puccinia flaccida Auth. Jour. Linn. Soc. Bot.,  
14:91. 1873.

Uredia VI (see page 73), urediospores cinnamon to chestnut, ellipsoid, 18-25 x 23-20 u, sidewall 1.5-2.5 u, pores 4-6; telia naked; teliospores golden brown to cinnamon, diorchidoid, ellipsoid or oblong, 15-25 x 26-45 u, sidewall 1-1.5 u, apical wall 2-4 u, pedicel 50 u. Host in tribe Paniceae.

Alternate host unknown.

## SPECIMENS EXAMINED:

on Echinochoa crussalli (L.) B. and Br.: Rooks Co.:

Bartholomew (Uredinae Exsiccate et Icones 21a), as Puccinia flaccida on Panicum crusgalli L., Sept. 23, 1896, II, III; Bartholomew (Sydow Uredineen 1069), as P. flaccida on Panicum crusgalli, Sept. 15, 1896, II, III; Bartholomew as P. flaccida on Panicum crusgalli, Sept. 23, 1895; Bartholomew (N. Am. Fungi, second series 3576), as P. flaccida on Panicum crusgalli, Sept. 1896, II, III; Stockton, Bartholomew (N. Am. Uredinales 35), as P. flaccida on Panicum crusgalli, Sept. 21, 1908, II, III.

2. Puccinia amphigena Diet., Hedw. 34:291. 1895. (Plate VIII, Fig. 2).

Uredia (VI), urediospores golden brown to cinnamon, globose or broadly ellipsoid 18-23 x 21-26 u, side wall 1.5-2 u thick, pores 8; telia naked; teliospores chestnut, oblong or oblong-clavate 18-30 x 30-56 u, side wall 1.5-2.5 u, apical wall 7-10 u, pedicel 50 u. Host on Agrostidae.

Alternate hosts in Liliaceae; reported in Kansas on Smilax and Yucca.

SPECIMENS EXAMINED:

on Calimovifa longifolia (Hook.) Hack.: Biley Co.: Manhattan, White, Dec. 31, 1921, III; Manhattan, White and Johnson, Feb. 1921, III. Rooks Co.: Bartholomew (Fungi Columb. 1567) March 3, 1867, III.

3. Puccinia andropogonis Schw. Trans. Am. Phil. Soc. II. 4:295. 1832. (Plate VIII, Fig. 3).

Uredia VI and V; urediospores globose or broadly ellipsoid 20-23 x 21-25 u, side wall 1.5-2 u, pores 4-6, telia naked; teliospores chestnut, obovoid or ellipsoid 16-21 x 30-44 u, side wall 1.5-2.5 u, apical wall 5-8 u, pedicel 70 u. Host *Andropogoniae*.

Alternate hosts reported in Kansas: Zanthoxylum, Oxalis, Aesculus, Baptisa, Commandra, Dalea and Petalstemun.

It is interesting to note that Puccinia andropogonis has only been found on Andropogon hallii Hack. in Riley County. This collection is on a grass that was moved from its normal western Kansas habitat to the Ashland Agronomy Farm. A smut, Sphacelotheca occidentalis (Seym.) Clint. has also had the same effect on the same host.

SPECIMENS EXAMINED:

on Andropogon gerardi Vitm.: Barton Co.: Cheyenne Bottoms, north end, Haard (14) and Kramer, Oct. 10, 1961, III. Butler Co.: 1.5 mi. NE of Keightly, Rogerson, Sept. 27, 1957, III. Coffee Co.: Route 75, 3 mi S of Burlington, Haard (16), Oct. 14, 1961; 10 mi S of Emporia, Haard (15), Oct. 14, 1961, III. Cloud Co.: W of Miltonvale, Rogerson and Hulbert, Nov. 1, 1957, III. Franklin Co.: Ottawa, Carleton and Meeker (989 and Duplicate Uredinales America, 12), on Andropogon provincialis Lam., Dec. 26, 1893, III. Jackson Co.: 5 mi E of Holton, Haard (21) and Kramer, July 2, 1958, III. Leavenworth Co.: Missouri river bottom, Kramer and Haard (19), July 20, 1958, II, III. Lyon Co.: Prairie

pasture, 2 mi S of Admire on K-99, Kramer (2587) and Duffield, Sept. 26, 1958, III. Reno Co.: Hutchinson, Kellerman and Swingle (2463), as Puccinia andropogonis on A. provincialis, Oct. 28, 1884, III; K-14, 5 mi S of Arlington, Haard (12), Sept. 15, 1961, III. Riley Co.: Manhattan, Thompson (17), on A. provincialis, March 16, 1890, III; Manhattan, Clothier, on A. furcatus, Sept. 1896, III; Agronomy Farm, Rogerson and Pickett, Sept. 3, 1954, II, III; Agronomy Farm, Rogerson, on Andropogon furcatus Muhl., Sept. 23, 1950, II, III; Ashland Agronomy Farm, Rogerson, July 25, 1955, II, III; 2 mi W of Tuttle Creek Dam on side road off K-13, Kramer and Haard (26), Sept. 26, 1958, III; 5 mi E junct. K-13 and U.S. 40 on K-13, Kramer and Haard (24), Sept. 19, 1958, III; Rooks Co.: Bartholomew (Sydow Uredineen 105 f.), on A. provincialis, Apr. 10, 1896, II, III; Rockport, Bartholomew (723), on A. provincialis, Sept. 29, 1892, III; Stockton, Bartholomew, (Fungi Columbaini 2652), on A. furcatus, Sept. 17, 1908; Rockport, Bartholomew, (Arthur and Holway: Exsiccate et Icones 39j), on A. furcatus, Sept. 24, 1894; Rockport, Bartholomew, (Sydow Uredineen, 1012), on A. provincialis, Sept. 24, 1894, III; Stockton, Bartholomew, (North American Uredinales), on A. furcatus, Sept. 15, 1911, II; Stockton, Bartholomew (Fungi Columb. 3541), on A. furcatus, Sept. 15, 1911, II; Rooks Co.: State Lake Park, N of Lake, Haard (17), Oct. 15, 1961, III; Wabaunsee Co.: 5 mi E junct. K-13 and U.S. 40, Kramer and Haard (23), Oct. 16, 1958, III; 1 mi E

1 mi E K-13 and 3 mi S U.S. 40, Haard (11), Sept. 11, 1961.

on Andropogon hallii Hack.: Riley Co.: K.S.C. Grass plots, Pickett and Rogerson, Aug. 1953, III; Soil Conservation Nursery, Ashland, Rogerson and Anderson, Oct. 1, 1951, III; Ashland Agronomy Farm, Rogerson, July 1955, II, III.

on Andropogon scoparius Michx.: Butler Co.: 5 mi W of Latham, Rogerson, Sept. 27, 1957, III; Cloud Co.: W of Miltonvale, Rogerson and Hulbert, Nov. 1, 1957, III; Franklin Co.: Ottawa, Meeker and Carleton (988), Dec. 28, 1893, III; Geary Co.: 2.5 mi S of junct. U.S. 40 and K-13 on K-13, Kramer and Haard (25), Sept. 9, 1958, III; McPherson Co.: K-61, 5 mi W of Rt. 18, Haard (13) Sept. 25, 1961, III; Reno Co.: Hutchinson, Kellerman, as P. andpogi, Oct. 28, 1889, III; Riley Co.: Manhattan, Thompson (19), March 16, 1891, III; Manhattan, Kellerman and Swingle (2297), Sept. 13, 1887, III; K.S.C. campus, Manhattan, Rogerson, Oct. 15, 1950, III; Rooks Co.: Rockport, Bartholomew (873), Jan. 25, 1893, III; Rockport, Bartholomew, Apr. 26, 1893, III; Bartholomew, (Sydow Uredineen 1165), Oct. 6, 1897, III; Stockton, Bartholomew, (N. Am. Uredinales 4254), Oct. 6, 1897, III; Stockton, Bartholomew, (Sydow Uredineen 2366) Bartholomew, Dec. 20, 1899, III; Rooks Co.: State Lake Park, N of lake, Haard (18), Oct. 15, 1961, III. Louisville, Bartholomew (N. Am. Uredinales 939), as Puccinia mariae-wilsoni (Peck.) Barth., III.

4. Puccinia aristidae Tracy, Jour Myc. 7:281. 1893 (Plate VIII, Fig. 4).

Syn: Puccinia sarcobati (Peck) Bethel, Published in Exiccet, N. Am. Uredinales 2064, 1921.

Puccinia subnitens Diet. Erythea III. p. 81 Syd. Mon. p. 748. 1895.

Uredia VIII; urediospores golden brown, globoid to broadly ellipsoid, side wall 3-5 u, pores 3-5 also equatorial, 18-24 x 19-33 u; telia naked; teliospores chestnut, broadly ellipsoid or obovoid-oblong, 18-29 x 30-50 u, side wall 2-4 u, apical wall 6-10 u, pedicel 130 u; host in Agrostidae, Festuceae and Zoysieae.

Alternate hosts reported in Kansas: Chenopodium, Corydalis, Dicentra.

SPECIMENS EXAMINED:

on Distichis stricta (Torr.) Rydb. Logan Co.: W of Russell Springs, Rogerson, June 20, 1957, II, III.

on Distichidis spicata (L.) Greene.: Ellis Co.: Bartholomew, as Puccinia subnitens on Distichidis maritima, July, 1910, III; Phillips Co.: Glade, Bartholomew, (North American Uredinales 265), as Puccinia sarrobatii, July 9, 1910, III.

5. Puccinia boutelouae (Jennings) Holw., Ann. Myc. 3:20 1890.

Uredia VI; urediospores hyaline to golden brown, globoid to ellipsoid 18-25 x 21-29 u, side wall 1-3 u, pores 8; telia naked; teliospores chestnut, globoid or broadly ellipsoid 18-24 x 23-30 u, side wall 2.5-3 u, apical wall 5-7 u, pedicel

100 u, usually obliquely attached. Hosts in tribe chloridae.

Alternate host unknown.

SPECIMENS EXAMINED:

on Bouteloua curtipendula (Michx.) Torr.: Riley Co.: near Pillsbury crossing, S of Manhattan, Ks., Rogerson, July 8, 1957. The rust was very immature and the uredia were still covered; I could not see either the II or III stage.

6. Puccinia chloridis Spog. Rev. Arg. Hist. Nat. 1:172. 1891. Plate VIII, Fig. 6).

Syn: Puccinia bartholomaei Diet., Hedw. 31:290. 1892.

Puccinia jamesiana (Peck) Arth. Bot. Gaz. 35:18. 1903.

Uredia VI; urediospore hyaline to golden-brown, ellipsoid to obovoid 18-22 x 18-23 u, side wall 1.5-2.5 u, 4-8 pores; telia naked, teliospores chestnut, oblong, 16-25 x 26-40 u, side wall 1.5-2.5 u, apical wall, pedicel 100 u. Host in tribe Chloridae.

Alternate hosts in Asclepidaceae. Reported in Kansas on Asclipas and Asclonidora.

SPECIMENS EXAMINED:

on Bouteloua curtipendula (Michx.) Torr.: Lyon Co.: 5 mi S of Olpe, Rogerson, July 26, 1957, II, III; Riley Co.: Hills S of Manhattan, Rogerson, as Puccinia bartholomaei Diet., Oct. 15, 1950 III; Agronomy Farm, Manhattan, Johnston and Rogerson, as P. bartholomaei, Oct. 8, 1950, III.

on Bouteloua gracilis (H.B.K.) Lagex Steud.: Rooks Co.:



Plate VIII

Fig. 1 Puccinia abnorminis.

on Echinochoa cruss-galli 4 X; spores 403 X.

Fig. 2 Puccinia amphigena.

on Calamovifa longifolia 4 X; spores 403 X.

Fig. 3 Puccinia andropogonis.

on Andropogon gerardi 4 X; spores 403 X.

Fig. 4 Puccinia aristidae.

on Distichidis stricta 4 X; spores 403 X.

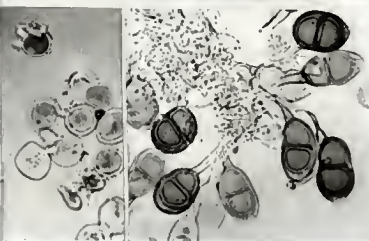
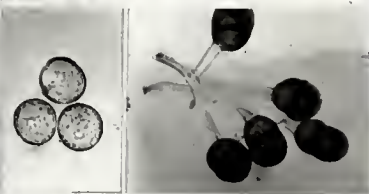
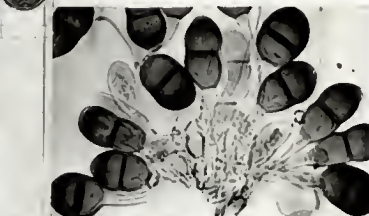
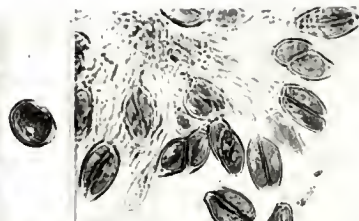
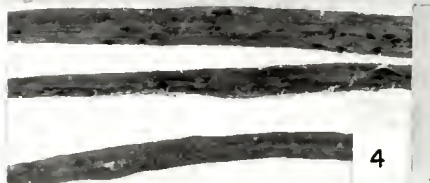
Fig. 5 Puccinia boutelouae.

on Bouteloua curtipendula 4 X; spores 403 X.

Fig. 6 Puccinia chlorides.

on Bouteloua curtipendula 4 X; spores 403 X.

## PLATE VIII



Stockton, Bartholomew, (N. Am. Uredinales 420) as Puccinia jamesiana, Aug. 23, 1910, III; Bartholomew (Arthor and Holway: Uredineen Exsiccate et Icones 59a) Aug. 21, 1895, III; Bartholomew (Sydow Uredineen 1061) as P. bartholomaei, on Bouteloua oligostachya (Nutt.) Torr. Oct. 24, 1896, III; Rockport, Bartholomew (872) as P. bartholomaei, on Bouteloua oligostachya, Jan. 25, 1893, III; Bartholomew (2990) as P. bartholomaei.

on Chloris verticillata Nutt. Butler Co: 5 mi W of Latham, Rogerson, Sept. 27, 1957, II, III; Riley Co: Manhattan, Pady, Jan. 28, 1955, II; Manhattan, Carleton (878), Dec. 16, 1893, III; City Park, Manhattan; Rogerson, July 21, 1957, II, K.S.C. Campus, Manhattan, Rogerson, Oct. 10, 1957, II, III; Books Co.: Stockton, Bartholomew (N. Am. Uredinales 2341) Aug. 23, 1920, II, (incorrect citation), Stockton, Bartholomew, (N. Am. Uredinales, 129), Nov. 29, 1910, III, Stockton, Bartholomew (Fungi Columb. 2657), Aug. 31, 1908, III.

7. Puccinia coronata Cda., Icon. Fung. 1:6. 1837. (Plate IX, Fig. 1).

Syn: Puccinia lolii Niels., Ugeskr. Landm. 1875.  
549. 1875.

Puccinia rhamni Wettst. Verh. Zool-Bot. Ges. Wien.  
35:545. 1886.

Uredia II, VI; urediospores hyaline-yellow, globoid to broadly ellipsoid, side wall 1-1.5  $\mu$ , pores 6-8, 13-26 x 14-36; telia naked or covered with paraphyses; teliospores

chestnut clavate to oblong, 10-22 x 30-95 u, coronate, side wall 1-1.5 u, apical wall 3-5 u, pedicel 20 u. Host in tribe Aveneae.

Alternate hosts in Rhamnaceae; reported in Kansas on Asparagus.

SPECIMENS EXAMINED:

on Avena sativa L.: Leavenworth Co.: 2 mi S of Reno highway, Leavenworth, Rogerson and Pady, May 19, 1945, II; Pottawatomie Co.: Louisville, Bartholomew (Fungi Columb. 3644), as Puccinia lolii, Oct. 18, 1911, II, III (and duplicate). (2 packets). Riley Co.: K.S.A.C. Manhattan, Botanical Dept. Coll. (1148), No date or collector; Manhattan, Thompson (68), July 9, 1891 III; K.S.A.C. rust nursery, Manhattan, Johnston and White, June 20, 1922, III; Rooks Co.: Stockton, Bartholomew (N. Am. Uredinales 1468) as Puccinia rhamni (Pers.) Wett. Oct. 25, 1915, II; Stockton, Bartholomew (Fungi Columb. 1974), July 6, 1904, II.

on Lolium perenne L.: Douglas Co.: Lawrence, McGregor (11053), Sept. 24, 1955, II; Lawrence, McGregor (1547), Oct. 5, 1956, II; Lawrence, McGregor (1546), Oct. 14, 1956, II; Riley Co.: K.S.C. campus, Manhattan, Rogerson, July 8, 1957, III; City Park, Manhattan, Rogerson, July 26, 1957, III.

8a. Puccinia cryptandri Ell. et Barth. Erythea. 5:47. 1897. var. cryptandri (Plate IX, Fig. 2).

Syn: Puccinia simulans Barth. N. Am. Uredinales. No. 32. 1922.

Uredia V, Urediospores cinnamon, narrowly ellipsoid or obovoid, side wall 2-2.5 u, pores 4-5, 18-26 x 26-40 u; telia naked; teliospores chestnut ellipsoid or oblong, side wall 1.5-3 u, apical wall 4-9 u, 24-32 x 40-54 u, pedicel 100 u. Hosts in Agrostidae.

Alternate host unknown.

SPECIMENS EXAMINED:

on Sporobolus Cryptandrus (Torr.) Gray.: Lincoln Co.: W of Shady Bend, Rogerson, June 3, 1957, II, III; Riley Co.: K.S.C. campus, Manhattan, Rogerson, July 19, 1956, III; Rooks Co.: Stockton, Bartholomew, (N. Am. Uredinales 32), issued as Puccinia cryptandri emended to Puccinia simulans (Pk.) Barth., Oct. 20, 1910, II, III; Bartholomew (Sydow Uredineen 1142) Oct. 20, 1894; Rockport, Bartholomew (Arthur and Holway: Uredinae Exsiccate et Icones 24a), July 27, 1894, II, III.

8b. Puccinia cryptandri Ell. and Barth. var. luxurians (Arth.) (Umn. and Green, Brittonia 13:274. 1961. Plate X, Fig. 5).

Syn: Puccinia luxuriosa Syd. Monog. Ured. 1:812. 1904.

Puccinia tosta Arth. Bull. Torr. Bot. Club. 29:288. 1902.

Uredia VI, urediospores ellipsoid or oblong 20-25 x 26-32, side wall 2-2.5 u, pores 6-8; telia naked; teliospores chestnut ellipsoid or oblong 23-33 x 40-60, side wall 1.5-2.5 u, apical wall 5-12 u, pedicel 115 u. Host tribe Agrostidae.

Alternate Host in tribe Chenopodiaceae.

## SPECIMENS EXAMINED:

on Sporobolus asperifolius (Nees and Man): Webster, Kansas: Bartholomew, as Puccinia luxuriosa, (Ellis and Everharts' Fungi Columbaini 2162), Sept. 17, 1905. This specimen resembles Puccinia schedonnardi Kell et Swing.

9. Puccinia distichidis Ell. and Everhd., Proc. Acad. Phila. 1893:152. 1893.

Uredia (VI, urediospores yellow, globose or broadly ellipsoid 23-28 x 26-33, pores 6-8; telia naked; teliospores chestnut, 19-27 x 42-64 u, side wall 1.5-2.5 u, apical wall 7-13 u, pedicel 115 u. Host in tribe Chloridae.

Alternate host in Primulaceae; not reported in Kansas on the alternate host.

This fungus is very difficult to separate from Puccinia sparganionoides. In the future it will not be advisable to give a positive identification unless both the uredial and telial stages are present. It is interesting to note that all of the collections from Kansas of P. distichidis are of the telial stage only. It could well be that P. sparganionoides is the only species of Puccinia parasitic on Spartina in Kansas.

## SPECIMENS EXAMINED:

on Spartina cynosuroides (L.) Roth. (probably Spartina pectinata Bosc.): Riley Co.: Manhattan, Thompson and Bartholomew (Kansas Fungi), Oct. 11, 1892, III.

on Spartina pectinata Bosc.: Coffee Co.: Junct. routes  
75 and 50, Haard (32), Oct. 10, 1961, III; Douglas Co.:  
Lawrence, Fergus, Nov. 11, 1941, III; Geary Co.: Brooks (201),  
April 11, 1936, III; Pottawatomie Co.: Rt. 16 1 mi E of Blaine,  
Haard (30), Sept. 18, 1961, III; Mabauance Co.: K 913 3 mi  
E of K-13, Haard (31), Sept. 15, 1961, III.

10. Puccinia dochima Berk. et Curt. Proc. Amer. Acad. 4:126.  
1858. (Plate IX, Fig. 4).

Uredia VI; urediospores yellow to golden brown, 12-18  
x 19-24 u, side wall 1-1.5 u, pores 6-8; telia naked;  
teliospores III ch. often diorchidoid, side wall 2-2.5 u,  
apical wall 3-7 u, pedicel 100 u. Host in Agrostidae.

Alternate host unknown.

SPECIMENS EXAMINED:

on Muhlenbergia glomerata (Willd.) Trin.: Rooks Co.:  
Bartholomew (Sydow Uredineen 1173), Oct. 6, 1897, III; Rockport,  
Bartholomew (727), Oct. 3, 1892, III.

on Muhlenbergia mexicana (L.) Trin.: Rooks Co.:  
Rockport, Bartholomew (Ell. and Everh. N. Am. Fungi, 2886),  
Oct. 1892; Bartholomew (Sydow Uredineen, 1068), Sept. 21, 1896.

11. Puccinia eatoniae Arth. Jour. Myc. 10:18. 1904. (Plate  
IX, Fig. 5).

Uredia VI; urediospores yellow to golden brown, globose or  
broadly ellipsoid, 12-18 x 19-24 u, side wall 1-1.5 u, pores  
6-8; telia covered with paraphyses; teliospores golden brown



to cinnamon, clavate-oblong or cylindric often angular, 11-19 x 30-50 u, side wall 1 u, apical wall 3-6 u, pedicel 12 u.

Host in the tribe Aveneae.

Alternate Host: Variety myosotidis Boraginaceae  
ranunculi Ranunculaceae

Neither alternate host has been reported for Kansas.

The following collection is the only collection of this species from Kansas. This was also the first time that this host species was collected in the state.

SPECIMENS EXAMINED:

on Spenopholis nitida (Bieker.) Scribn.: Crawford Co.:  
1 mi N of Pittsburg, Rogerson (R. 3761), June 3, 1955, II,  
III.

12. Puccinia ellisiana Thuem., Bull. New York Botan. Club.  
p. 215. 1878. (Plate IX, Fig. 6).

Uredia VII; urediospores golden brown to cinnamon, globoid 18-20 x 19-22 u, side wall 2.5-4 u, 3-4 pores, telia naked, teliospores chestnut, ellipsoid or obovoid 18-23 x 31-45 u, side wall 2-3 u, apical wall 7-9 u, pedicel 85 u. Host in tribe Andropogoneae.

Alternate host in Violaceae. Reported in Kansas on  
Viola.

on Andropogon gerardi Vitm.: 4 miles E K-13 and 2 mi  
S U.S. 40, Haard, (35), Oct. 4, 1961. III.

on Andropogon scoparium Michx.: Pottawatomie Co.:



Plate IX

Fig. 1 Puccinia coronata.

on Avena sativa 4 X; spores 403 X.

Fig. 2 Puccinia cryptandri var. cryptandri.

on Sporobolus cryptandrus 4 X; spores 403 X.

Fig. 3 Puccinia distichidis.

on Spartina pectinata 4 X; spores 403 X.

Fig. 4 Puccinia dochmia.

on Muhlenbergia glomerata 4 X; spores 403 X.

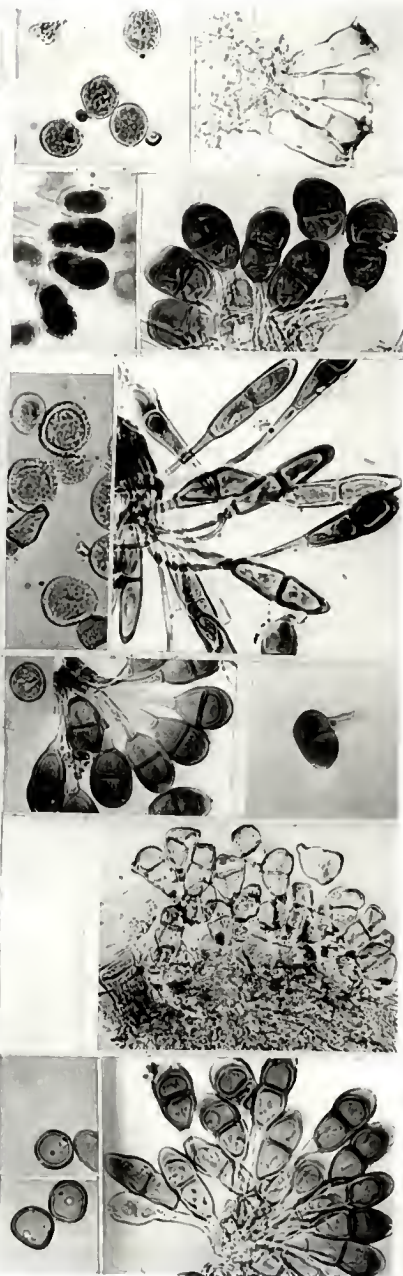
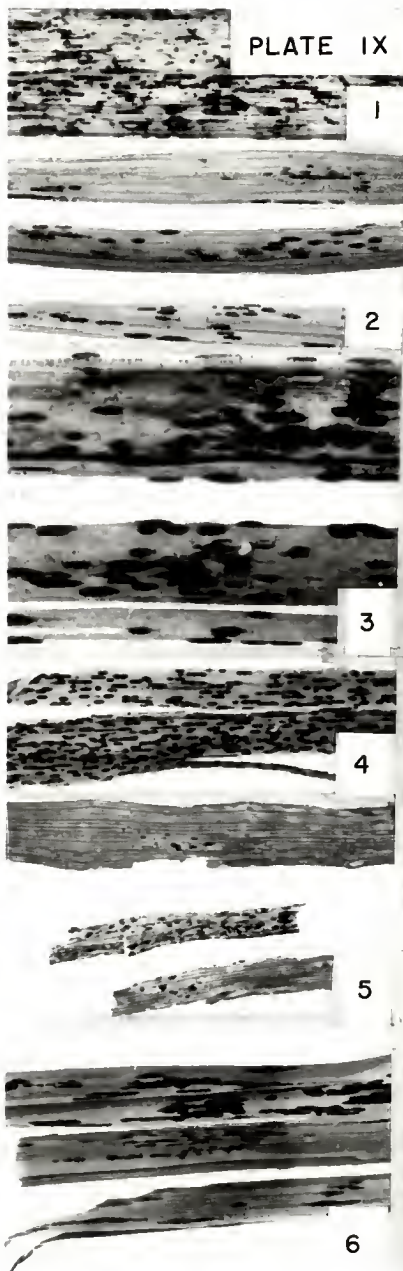
Fig. 5 Puccinia eatoniae.

on Sphenopholis nitida 4 X; spores 403 X.

Fig. 6 Puccinia ellisiana.

on Andropogon scoparius 4 X; spores 403 X.

## PLATE IX



K 99, 7 mi N of Wamego, Haard (33), Oct. 18, 1961; Riley Co.: Agronomy Farm, Manhattan, Rogerson, no date, III; Rooks Co.: Bartholomew (Arthur and Holway: *Uredineae Exsiccatae et Icones* 38a); Bartholomew, Dec. 25, 1895, III; Wabaunsee Co.: on K-913 3 mi E of K-13, high pasture, Haard, Sept. 15, 1961, III.

13. Puccinia emaculata Schw., Trans. Am. Phil. Soc. II 4:295. 1852. (Plate X, Fig. 1).

Uredia V; urediospores cinnamon, broadly ellipsoid 18-23 x 21-26 u, side wall 1.5-2 u, pores 3-4, telia naked, teliospores chestnut, ellipsoid or oblong 16-23 x 30-44 u, side wall 1.5-2, apical wall 4-8 u, pedicel 60 u. Host tribe in Paniceae.

Alternate host unknown.

This rust resembles Puccinia panici Diet. differing only slightly in measurements. If only one stage is present (either II or III) it is impossible to distinguish these species. The specimens in the Kansas State University Herbarium actually seemed closer to Puccinia panici than P. emaculata. I have let these stand arbitrarily as P. emaculata until a better understanding of these species is reached.

#### SPECIMENS EXAMINED:

on Panicum capillare L.: Riley Co.: Manhattan, Kellerman and Swingle (2552), Oct. 24, 1887, III; Manhattan, Carleton (*Uredineae Americanae* 37), 1892-3, II, III; Manhattan,

Thompson (117), Jan. 13, 1892, III; Manhattan, Botanical Dept. (1143), no date or collector, III. Rooks Co.: Stockton, Bartholomew, (Fungi Columb. 2148), Sept. 29, 1905, I; Stockton, Bartholomew (N. Am. Uredinales), Sept. 8, 1908, II, III; Stockton, Bartholomew (Fungi Columb. 2054), Sept. 8, 1904, III. Sedgwick Co.: Wichita, Kellerman and Swingle (2475), Oct. 25, 1889, III.

on Panicum virgatum L.: Riley Co.: Manhattan, Thompson (197), Sept. 7, 1892, III.

14. Puccinia graminis Pers., Neuses, Mag. Bot. 1:119. 1794: Syn. Fung. 228. 1801. (Plate X, Fig. 2).

Syn: Puccinia poculiformis (Jacq.) Wettst. Verh. Zool-Bot. Ges. Wien. p. 544. 1885.

Puccinia jubata Ell. and Barth. Erythea 4:2. 1896.

Uredia V; urediospores golden brown to cinnamon, oblong or ellipsoid 13-24 x 21-42 u, wall 1.5-2 u, pores 4; telia naked; teliospores chestnut, ellipsoid or oblong clavate 16-23 x 35-55 u, side wall 1.5 u, apical wall 5-10 u, pedicel 50 u. Host in tribes Paniceae, Phalarideae, Agrostidide, Aveneae, Chloridae, Festuceae, Hordeae.

Alternate host in Berberidaceae. Reported in Kansas on Berberis.

#### SPECIMENS EXAMINED:

on Aegilops cylindrica Host.: Ellis Co.: Rogerson, June 10, 1954, II; Republic Co.: 10 mi S of Belleville, Rogerson, June 26, 1957, II.

on Aegilops cylindrica Host X Triticum aestivum L.  
(Natural hybrid): Ellis Co.: Rogerson and Johnston, June 10, 1954, II.

on Agropyron smithii Rydb. Clark Co.: 5 mi E of Ashland on U.S. 60, Kramer and Haard (37), July, 1958, II, III.  
Ford Co.: 8 mi E of Dodge City, Kramer and Haard (38), Sept. 4, 1958. Ottawa Co.: Dennington, Rogerson, Oct. 11, 1956, II. Smith Co.: 10 mi W of Smith Center, Rogerson, June 10, 1955, II; Lebanon, Pady, June 22, 1955, II, III.

on Agrostis alba L. var. vulgaris ? : Riley Co.: Manhattan, Thompson (186), Aug. 31, 1892, III; Manhattan, Thompson (204), Oct. 1892, III; Manhattan, Botanical Dept. (1141), no collector or date.

on Agrostis hiemalis (Walt.) D.S.P.: Cherokee Co.: SE of Weir, Rogerson, June 11, 1957, II.

on Avena sativa L.: Marion Co.: Rogerson, June 27, 1955, II. Riley Co.: Manhattan, Smith, Norton, and Dorman, (Uredineae Americanae 9), July, 1893, III; Manhattan, Kellerman and Swingle (2004), June 19, 1889, II. Rooks Co.: Rockport, Bartholomew (Arthur and Holway Uredineae Exsiccate et Icones 30f), as Puccinia poculiformis, Sept. 7, 1907; Stockton, Bartholomew (Fungi Columb. 2266), as P. poculiformis, July 6, 1904, II; Stockton, Bartholomew (Fungi Columb. 2066), as P. poculiformis, July 6, 1904, II.

on Avena sp.: Greenwood Co.: Eureka, Hitchcock, summer,

1892, on Oats, III. Riley Co.: Manhattan, Oct. 11, 1889,  
no collector, III.

on Bromus japonicus Thumb.: Riley Co.: Manhattan,  
Lefebvre, July 18, 1935, III, (scant material).

on Bromus secalinus B.: Riley Co.: Manhattan, Thompson,  
July 8, 1892, III.

on Bromus sp.: Riley Co.: Manhattan, Carleton, Nov. 21,  
1892, III.

on Calamagrostis longifolia (Hook.) Scribern.: Riley  
Co.: Manhattan, Thompson (193), Sept. 2, 1892, III.

on Dactylis glomerata L.: McPherson Co.: McPherson,  
Kirby, Nov. 28, 1919, II. Riley Co.: City Park, Manhattan,  
Rogerson, July 19, 1956, II.

on Elymus canadensis L.: Jewell Co.: Rogerson, July  
27, 1953, II. Rocks Co.: Rockport, Bartholomew, Aug. 24,  
1892, III. Wabaunsee Co.: 4 mi S of Alma, Rogerson, July  
8, 1953, II.

on Elymus virginicus L.: Riley Co.: K.S.C. Grass Plots,  
Manhattan, Rogerson, June, 1953, II; along Rock Island R.R.  
Manhattan, Rogerson, June 24, 1954, II. Wichita Co.: 5 mi  
S of Leoti, Haard, Oct. 9, 1961, II, III.

on Hordeum brachyantherum Nevski: Riley Co.: K.S.A.C.  
Grass Nursery, Manhattan, White and Johnston, June 6, 1921,  
II, III.

on Hordeum jubatum L.: Ottawa Co.: NE Ottawa County,  
Rogerson, July 9, 1953, II. Phillips Co.: Bartholomew (1680),  
 Type specimen of Puccinia jubata, March 7, 1895, II, III.  
Riley Co.: Manhattan, Thompson (154), Aug., 1892, III.  
Stafford Co.: Carleton, Oct. 8, 1892, II, III.

on Hordeum vulgare L.: Franklin Co.: Ottawa, Pady,  
 June 25, 1940, II. Rooks Co.: Bartholomew, (Fungi Columb.  
 2153), July 12, 1904, as Puccinia poculiformis, II, III;  
Bartholomew, (N. Am. Uredinales 3348), July 20, 1923, III.

on Poa annua L.: Riley Co.: City Park, Manhattan,  
Rogerson, Oct. 15, 1957, II..

on Poa arida Vasey.: Ellis Co.: Hays Expt. Sta.,  
Rogerson, June 8, 1956, II. Riley Co.: Ashland Agronomy  
 Farm, Rogerson (R. 3745), June 6, 1955, II.

on Poa pratensis L.: Dickinson Co.: Abilene, Rogerson  
 (R. 3735), Oct. 4, 1954, II. Oberlin Co.: Decatur, Rogerson,  
 Sept. 11, 1956. Riley Co.: Manhattan, 920 Claflin Road,  
Rogerson (R. 3734), June 9, 1954, II; Manhattan, Rogerson,  
 Oct. 17, 1956, II; K.S.C. Turf Plots, Manhattan, Rogerson,  
 on var. Penn. 65, Oct. 17, 1956, II; Manhattan, Pady, Sept.  
 29, 1957, II; K.S.C. Turf Plots, Manhattan, Rogerson, Oct.  
 17, 1956, II; K.S.C. campus, Manhattan, Rogerson, Oct. 10,  
 1957, II; K.S.C. Turf Plots, Manhattan, Rogerson, Oct. 10,  
 1957, II; K.S.C. campus, Manhattan, Rogerson, Oct. 16, 1957,  
 II; K.S.C. Turf Plots, Manhattan, Rogerson, Oct. 17, 1956,



II; Manhattan, Rogerson, Sept. 28, 1957, II; Manhattan, Rogerson, (R. 3737), June 23, 1955, II. Rooks Co.: Stockton, Rogerson (R. 3736), June 3, 1955, II. Sedgwick Co.: Wichita, Rogerson, on Merian blue grass, May 29, 1957, II. Shawnee Co.: Gage Park, Topeka, Rogerson, Oct. 25, 1954, II. Smith Co.: Smith Center, Rogerson, on Merion Bluegrass, July 3, 1957, II.

on Secale cereale L.: Linn Co.: Rogerson and Hansing, June 22, 1954, II.

on Sporobolus cryptandrus (Torr.) A. Gray: Riley Co.: Ashland Agronomy Farm, Rogerson (R. 3765), Oct. 14, 1955, II.

on Sporobolus sp.: Geary Co.: Along Republic River, Rogerson, July 23, 1956, II.

on Triticum aestivum L.: Cloud Co.: Carleton, April 27, 1887, II, III. Franklin Co.: 3 mi S of Ottawa, Pady, June 21, 1942, on Kawvale wheat II; W of town, Ottawa, Pady, June 21, 1940, II. Riley Co.: Manhattan, Carleton, (Uredineae Americanae 29), on Triticum vulgare Vill., July, 1893, II, III. Rooks Co.: Stockton, Bartholomew, (Fungi Columb. 1973), on Triticum vulgare as P. poculiformis, July 14, 1904.

on Triticum spelta L.: Rooks Co.: Stockton, Bartholomew, (Fungi Columb. 2154), as P. poculiformis, July 15, 1904, III.

on Triticum sp. Rooks Co.: Rockport, Bartholomew, on Wheat Straw, III.



15. Puccinia hordei Fekl., Jahrb. Ver. Nat. Nassau 15:16.  
1860.

Syn: Puccinia anomala Rostr., Thüm., Flora 61:223.  
1878.

Puccinia simplex Erikss. Henn., Zeits. Pflanzentzenkr  
4:260. 1894. Not P. simplex. Peck 1881.

Uredia VI; urediospores yellow, ellipsoid or obovoid  
16-24 x 22-29 u, side wall 1.5-2 u, pores 8-10; telia covered  
with paraphyses; teliospores chestnut often angular, obovate  
or clavate, 18-25 x 39-58 u, side wall 1.5 u, apical wall  
3-6 u, pedicel 15 u, mesospores numerous. Host in tribe  
hordeae chloridae.

Alternate host in Liliaceae. Known only from Europe.

SPECIMENS EXAMINED:

This fungus has been reported in Kansas, but there are  
no Kansas specimens in the Kansas State Herbarium.

16. Puccinia imposita Arth., Bull Torrey Bot. Club. 46:  
112. 1902. (Plate X, Fig. 3).

Uredia V; urediospores cinnamon, globoid or broadly  
ellipsoid 23-30 x 27-35 u, side wall 1.5-2.5 u, pores 3-4;  
telia naked; teliospores chestnut oblong or clavate 19-25  
x 38-52 u, side wall 1.5-2.5 u, apical wall 5-8 u, pedicel  
15 u. Host in tribe Paniceae.

Alternate host unknown.

SPECIMENS EXAMINED:

Leptaloma cognatum (Schult.) Chase: Butler Co.: 5  
mi W of Latham, Rogerson, Sept. 27, 1957, II, III. Riley Co.:

Grass Nursery, Manhattan, Rogerson, Oct. 13, 1957, II, III.  
Wyandotte Co.: Wyandotte Co. State Park, Rogerson, Aug. 9,  
 1956, II, III.

17. Puccinia kansensis Ell. and Barth., Erythea 4:11896.  
 (Plate X, Fig. 4).

Uredia VI; urediospores hyaline, globoid 15-18 x 17-22 u, side wall 1.5-2 u, pores 6; telia naked; teliospores chestnut, ellipsoid 16-19 x 24-32 u, side wall 1.5-2.5, apical wall 2-2.5 u, pedicel 30 u and fragile, lower pore in each cell is often depressed. Host in tribe chloridae.

Alternate host unknown.

#### SPECIMENS EXAMINED:

on Buchloes dactyloides (Nutt.) Engelm.: Butler Co.: 5 mi W of Latham, Rogerson, Sept. 27, 1957, III; 5 mi W of Latham, Rogerson, July 26, 1957, II, III. Ellis Co.: Saline River, Bartholomew (1921), Sept. 9, 1895, III. Rooks Co.: Bartholomew (1912), Aug. 30, 1895, II, III; Bartholomew (1577), Sept. 17, 1894, II, III; Bartholomew, (N. Am. Fungi 3351), Aug. 1895, II, III; Bartholomew (Sydow Uredineen 1073), Oct. 16, 1896, III; Bartholomew, Arthur and Holway: (Uredineen Exsiccate et Icones (60a), on Bulbis dactyloides (Nutt.), Raf, Aug. 19, 1895, II, III; Stockton, Bartholomew, (Fungi Columb. 2664), on Bulbis dactyloides, July 18, 1908, II; Stockton, Bartholomew, (N. Am. Uredinales 151), on Bulbis dactyloides, Aug. 17, 1910, III.

18. Puccinia montanensis Ellis, Jour. Myc. 7:274. 1893.  
(Plate X, Fig. 6.).

Uredia II; urediospores yellow to cinnamon, ellipsoid 19-26 x 21-32 u, side wall 1.5-2, pores 8-10; paraphyses mostly clavate; telia covered with paraphyses; teliospores chestnut irregularly oblong, angular, 18-34 x 35-64 u, side wall 1.5-2.5 u, apical wall 3-7 u, pedicel 10 u. Hosts in tribes Festuceae and Hordeae.

Alternate host in Berberidaceae.

SPECIMENS EXAMINED:

on Elymus canadensis L.: Phillips Co.: Riley Co.:  
Manhattan, Thompson (56), July 29, 1891, III; Manhattan,  
Thompson (Carleton Uredineae Americanae 22), July 1891, III.  
Rooks Co.: Bartholomew, Oct. 10, 1894, II, III; Bartholomew  
(Fungi Columb. 1859), Sept. 23, 1903, II, III.

on Elymus virginicus L.: Phillips Co.: Kensington,  
Bartholomew (Fungi Columb. 1969), Aug. 11, 1903, III.  
Riley Co.: Manhattan, Thompson (67), July 3, 1891, III.

18. Puccinia panici Diet.\* Erythea 3:80. 1895. (Plate  
XI, Fig. 1).

Syn: Puccinia pammelii (Trel.) Arth., Jour. Myc. 11:  
56. 1905.

Uredia V; urediospores broadly ellipsoid 19-27 x 21-30  
u, side wall 1.5-2 u, pores 3-4; telia naked; teliospores

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\* See discussion under Puccinia emaculata.

Plate X

Fig. 1 Puccinia emaculata.

on Panicum capillare 4 X; spores 403 X.

Fig. 2 Puccinia graminis.

on Elymus virginicus 4 X; spores 403 X.

Fig. 3 Puccinia imposita.

on Leptoloma cognatum 4 X; spores 403 X.

Fig. 4 Puccinia kansensis.

on Buchloe dactyloides 4 X; spores 403 X.

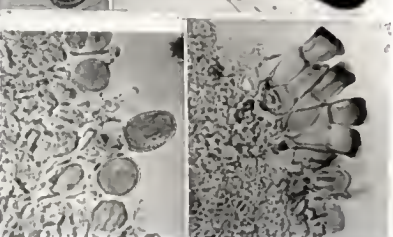
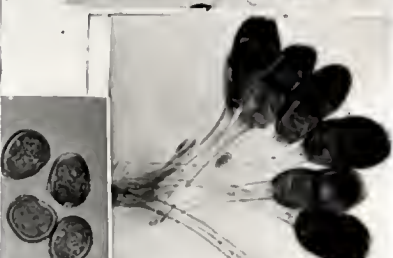
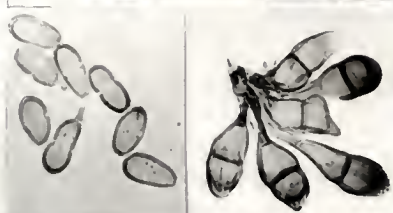
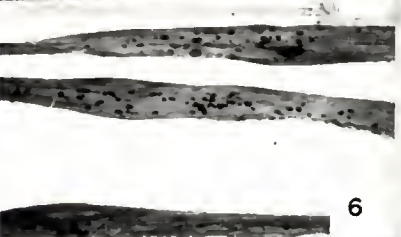
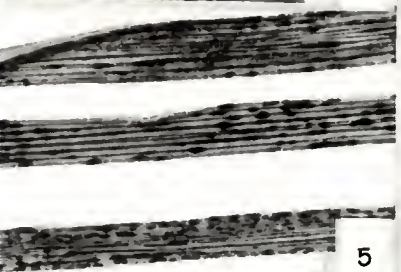
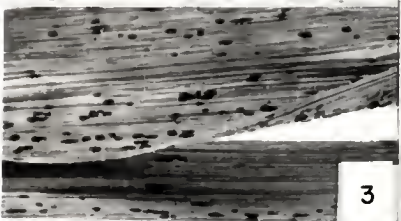
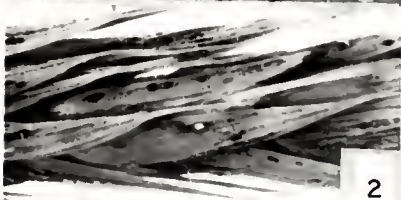
Fig. 5 Puccinia cryptandri var luxuriosa.

on Sporobolus airoides 4 X; spores 403 X.

Fig. 6 Puccinia montanensis.

on Elymus canadensis 4 X; spores 403 X.

## PLATE X



chestnut, ellipsoid or oblong, 16-23 x 30-45 u, side wall 1.5-2 u, apical wall 3-7 u, pedicel 75 u, host in tribe Paniceae.

Alternate host in Euphorbiaceae. Reported in Kansas on Euphorbia and Tithymalopsis.

SPECIMENS EXAMINED:

on Panicum virgatum L.: Riley Co.: Thompson leg Bartholomew (Kansas Fungi Fascicle VI, 20), Sept. 7, 1892, III. Rooks Co.: Stockton, Bartholomew, (N. Am. Uredinales 251), as Puccinia pammelii, Nov. 10, 1910, III: Rockport, Bartholomew (Uredineae Exsiccate et Icones 20a), Oct. 1894, II, III; Rockport, Bartholomew (N. Am. Fungi, Second Series, 3084), Sept. 1893, III; Bartholomew, (Sydow Uredineen 1178), Oct. 15, 1897, III.

19. Puccinia phragmites (Schum.). Korn., Hedw. 15:179. 1876. (Plate XI, Fig. 2).

Uredia V; urediospores cinnamon oblong ellipsoid or obovoid 18-21 x 29-34 u, side wall 3-4 u, pores 4; telia naked; teliospores golden brown to chestnut, oblong 16-21 x 45-64 u, side wall 2-3.5 u, apical wall 4-7 u, pedicel 200 u. Host in tribe Festuceae.

Alternate host in Polygonaceae.

There are several collections of this species as on Spartina spp; this is a mistake in identification for Puccinia sparganioides Ell. and Barth. and all of these collections are listed under this species.

## SPECIMENS EXAMINED:

on Phragmites communis Trin.: Atchison Co.: Muscotah,  
Kramer 755, Sept. 23, 1954, III. Hamilton Co.: Coolridge,  
Carleton (Uredineae Americanae 36), Oct. 1892, III.

20. Puccinia poae-nemorialis Otth. Mitth. Naturf. Ges. Bern.  
 1870:113. 1871. (Plate XI, Fig. 3).

Syn: Puccinia poae-sudenticae Jorstad Nyt. Mag. f.  
 Naturv. 70:325. 1932.

Uredia II; urediospores hyaline-yellow, globose or ellipsoid  
 17-24 x 22-29 u, side wall 1.5-2 u, pores 8 paraphyses clavate-  
 capitate, curved, neck constricted, amphispores occasional;  
 telia covered with paraphyses; teliospores chestnut, oblong  
 or somewhat clavate, 14-20 x 36-50 u, side wall 1.5 u, apical  
 wall 3-6 u, pedicel 10 u. Host in tribe Agrostidae.

Alternate host unknown.

## SPECIMENS EXAMINED:

on Poa pratensis L.: McPherson Co.: Canton, K.S.C.  
 Exp. Field, Pady and Rogerson as Puccinia poae-sudentinae,  
 May 28, 1954, II. Ottawa Co.: O.U. Campus, Ottawa, Pady,  
 as P. poae-sudentinae, Nov. 11, 1944, II. Riley Co.: K.S.C.  
 Campus, Manhattan, Rogerson, as P. poae-sudenticae, May 18,  
 1952, II; Manhattan, Wareham and Rogerson, as P. poae-sudenticae,  
 June 28, 1955, II; Ashland Agronomy Farm, Rogerson, as P.  
poae-sudenticae, June 15, 1955, II; Grass Breeding Nursery,  
 Manhattan, Rogerson, as P. poae-sudenticae, June 6, 1955,  
 II.



on Poa sp. (Intra-specific hybrids): Riley Co.: K.S.C.  
Turf Plots, Manhattan, Rogerson and Keen on plants FC 32756, FC  
32736, FC 32748, FC 32702, July 1957, II; K.S.C. Turf Plots,  
Johnston, Keen and Rogerson, on plants 32700, June 6, 1957,  
II.

21. Puccinia poarum Bot. Tidsskr. III. 2:34. 1877.

Syn: Puccinia epiphylla. Wettst., Berh. Zool-Bot.  
Ges. Wien 35:541. 1886.

Uredia VI; urediospores hyaline to yellow, 16-24 x 19-  
29 u, pores 6-8, side wall 1-1.5; telia covered with paraphyses;  
teliospores chestnut, oblong, cylindric or clavate, 15-23  
x 35-55 u, side wall 1-1.5 u, apical wall 3-7 u, pedicel 10  
u. Host in tribe Festuceae.

Alternate host in Compositeae tribe Senecioneae. Not  
reported in Kansas on the alternate host.

This fungus is apparently not present in Kansas. A  
Fungi Columbiana specimen (1862) by Bartholomew was apparently  
misidentified and should be Puccinia poae-nemoralis Oth.  
It will remain on the list of Kansas Fungi till other specimens  
are examined if they exist. All of the Fungi Columbiana  
specimens in the herbarium from other areas were also examined  
and were also found to be P. poae-nemoralis thus indicating  
a misconception of this species by early workers.

22. Puccinia purpurea Cooke, Grev. 5:15. 1876. (Plate XI,  
Fig. 4).



Uredia II; urediospores cinnamon, 23-29 x 30-40, side wall 2 u, pores 5-8 u; paraphyses clavate-capitate usually curved; telia naked; teliospores chestnut, 24-30 x 40-50 u, side wall 3-3.5 u, apical wall 4-5 u, pedicel 95 u. Host in tribe Andropogoneae.

Alternate host unknown.

SPECIMENS EXAMINED:

on Sorghum vulgare Pers. Riley Co.: Manhattan, Johnston, Black Spanish Broom Corn, Sept. 10, 1929, II.

on Sorghum (Salimonicolor?): Riley Co.: Agronomy Farm, Manhattan, Rogerson, Sept. 23, 1950, II.

on Sorghum (dura): Riley Co.: Manhattan, Johnston, Oct. 27, 1931, II.

on Sorghum SudanXJohnson grass: Riley Co.: Agronomy Farm, Manhattan, Johnston and Rogerson, Oct. 18, 1950, II, III.

on Atlas sorgho X Johnson grass (natural hybrid): Riley Co.: Bruce Wilson Farm, Keats, Johnston, Sept. 17, 1937.

on Sorghum halapense (L.) Pers.: Wabaunsee Co.: 3 mi E of K-13 and 2 mi S of U.S. 40, Haard (56), Oct. 4, 1961.

23. Puccinia recondita Rob. ex Desm., Bull. Soc. Bot. France. 4:798. 1857. (Plate XI, Fig. 5).

Syn: Puccinia asperfoli111 (Pers.) Wett., Verh1. Zool-Bot. Ges. Wein. p. 158. 1885.

Puccinia rubigo-vera (D.C.) Wint. Rab., Krypt. Fl.  
1:217. 1881.

Puccinia agropyri Eh. and Ev., Jour. Mycology.  
7:131. 1892.

Puccinia dispersa Erikss. and Henn.

Puccinia impatiens (Schw.) Arth. Bot. Gaz. 35:  
19. 1903.

Uredia VI; urediospores yellow-cinnamon, globose or broadly ellipsoid 14-32 x 16-18 u, wall 1-2 u, pores 6-10. Telia covered with paraphyses; teliospore chestnut 10-25 x 32-85 u, side wall 1-1.5 u, apical wall 3-7 u, pedicel 10 u. Host in tribes Agrostidae, Aveneae, Festuceae, and Hordeae.

Alternate host on the tribes Boraginaceae, Hydrophyllaceae, Balsaminaceae of the Ranunculaceae.

#### SPECIMENS EXAMINED:

on Agropyron intermedium (Host.) Beauv.: Riley Co.: Ashland Agronomy Farm, Rogerson and Pickett (3792-11-20), June, 1954, II. Rooks Co.: Bartholomew (1938), on Agropyron glaucum as Puccinia agropyri Ell. and Ev., Sept. 16, 1895, III. The Hitchcock collection of Puccinia rubigo-vera (D.C.) cited on page , some teliospores of Puccinia graminis Pers. present. Since there was rather sparse material, an effort should be made to collect rusts on this host species to carry on further studies.

on Aegilops cylindrica Host Triticum aestivum L.: McPherson Co.: 3 mi S of Moundridge, Rogerson, Pady and Johnston, May 29, 1957, II, III.

on Agropyron smithii Rydb.: Winney Co.: 8 mi E of Garden City, Haard (58) and Kramer, Oct. 10, 1962, II, III. Riley Co.: K.S.C. Grass Plots, Manhattan, Rogerson and Pickett (2539-19), July, 1953, II. Rooks Co.: Bartholomew (Fungi Columb. 1639), on Agropyron occidentale as P. agropyri, July 18, 1902, II, III; Stockton, Bartholomew (Fungi Columb. 3348), on Agropyron occidentale, June 27, 1910, II.

on Agrostis alba L.: Ottawa Co.: NE Ottawa Co., Rogerson as P. rubigo-vera, July 9, 1953, II.

on Elymus canadensis L.: Linn Co.: Rt. 69, Rogerson and Hansing, as P. rubigo-vera, June 22, 1954, II. Ottawa Co.: NE Ottawa Co., Rogerson, as P. rubigo-vera, July 9, 1953, II. Rooks Co.: Stockton, Bartholomew (N. Am. Uredinales, 1656), as Puccinia impatientis, Sept. 28, 1914, II, III. Sumner Co.: N of Caldwell, Rogerson and Johnston as P. rubigo-vera, May 27, 1954, II. Woodson Co.: 1 mi N of Toronto, Rogerson as P. rubigo-vera, June 3, 1955, II.

on Elymus virginicus L.: Marshall Co.: Blue Rapids, Bartholomew (N. Am. Uredinales, 3355), as P. impatiens, June 29, 1925, II, III. Riley Co.: along Wildcat Creek, W of Manhattan, Rogerson, July 21, 1956, II, III; along Wildcat Creek, W of Manhattan, Rogerson, as P. rubigo-vera, July 24, 1955, II, III. Rooks Co.: Stockton, Bartholomew, (N. Am. Uredinales, 556), as P. impatientis, July 10, 1910, II, III.

on Hordeum jubatum L.: Barton Co.: Cheyenne Bottoms, Haard, (59) and Kramer, Oct. 10, 1961, II.

on Koeleria cristata (L.) Pers.: Greenwood Co.: Eureka, Hitchcock, summer 1892, II, III.

on Secale cereale L.: Cloud Co.: 1 mi N of Concordia, Rogerson, June 26, 1957, II. Doniphan Co.: Wathena, Eshbaugh and Rogerson, Oct. 16, 1957, II. Douglas Co.: Lawrence, Pady, as Puccinia dispersa on Rye, May 17, 1944, II. Johnson Co.: N of Spring Hill, Rogerson, June 10, 1957, II, also duplicate specimen label saying, "paraphyses present"; could not see any paraphyses. Kingman Co.: Pady and Rogerson, as P. rubigo-vera, May 27, 1954, II. Labette Co.: Rogerson, as P. rubigo-vera D.C. Wint., f. sp. secalis (Erlis.) Carleton, June 4, 1953, II. Leavenworth Co.: E. McLouth, Pady and Rogerson, as P. rubigo-vera f. sp. secalis, June 2, 1955, II. Miami Co.: N of Osawatomie, Rogerson, June 10, 1957, II. Montgomery Co.: NE of Montgomery, Rt. 169, Rogerson and Pady, as P. rubigo-vera f. sp. secalis, June 3, 1955, II. Nemaha Co.: 6 mi E of Kelly, Rogerson, as P. rubigo-vera, June 17, 1955, II, III. Pratt Co.: E of Pratt, Rogerson and Pady, as P. rubigo-vera f. sp. secalis, May 24, 1954, II. Rice Co.: E of Lyons, Rogerson, as P. rubigo-vera f. sp. secalis, June 8, 1954, II. Riley Co.: Manhattan, Carleton, as P. rubigo-vera on Rye, June 25, 1962; Ashland, Rogerson, as P. rubigo-vera, May 17, 1962, II. Rooks Co.: Stockton, Bartholomew (N. Am. Uredinales 2227, 2226), as P. asperfolii, Aug. 5, 1919, III, June 13, 1919, II, June 15, 1903, II; Stockton, Bartholomew, (Fungi Columb. 1865) as P. rubigo-vera, June 15,

1903, II. Wilson Co.: E of Fredonia, Rogerson and Pady, as P. rubigo-vera f. sp. secalis, June 3, 1955, II.

on Triticum vulgare Vill.: Clay Co.: E of Clay Center, Rogerson, June 26, 1957, II. Decatur Co.: Hitchcock, on wheat, as P. rubigo-vera, June 25, 1892, III. Ford Co.: Bucklin, Hitchcock, as P. rubigo-vera, Summer, 1892, III. Jewell Co.: Mankato, Ks., E. A. Kern, on wheat as P. rubigo-vera, June 12, 1891. McPherson Co.: Riley Co.: Manhattan, Kellerman and Swingle (2170), on wheat as P. rubigo-vera, June 12, 1888; Manhattan, Thompson (60), as P. rubigo-vera, on wheat, July 4, 1891, III; College (Manhattan), Carleton as Uredo rubigo-vera, June 21, 1892, II. Rocks Co.: Stockton, Bartholomew (Fungi Columb. 1866), as P. rubigo-vera, July 7, 1903, III; Rockport, Bartholomew (Kansas Fungi 16), as P. rubigo-vera, June 27, 1892, III; Rockport, Bartholomew (Kansas Fungi 15), as P. rubigo-vera, host as winter wheat, June 25, 1892, II. Sedgwick Co.: A. S. Miller, as P. rubigo-vera, on wheat, May 17, 1892, II, III. Seward Co.: Liberal, Hitchcock, as P. rubigo-vera, July 1892, II, III.

24. Puccinia redfieldiae Tracy, Jour. Myc. 7:281. 1893.  
(Plate XI, Fig. 6).

Uredia VII; urediospores cinnamon ellipsoid 18-24 x 24-29 u, side wall 2-3 u, pores 4. Telia naked; teliospores chestnut ellipsoid 21-26 x 33-50 u, side wall 2-3 u, apical wall 4-8 u, pedicel 10 u. Host in tribe Festuceae.

Plate XI

Fig. 1 Puccinia panici.

on Panicum virgatum 4 X; spores 403 X.

Fig. 2 Puccinia phragmites.

on Phragmites communis 4 X; spores 403 X.

Fig. 3 Puccinia poae-nemoralis.

on Poa pratensis 4 X; spores 403 X.

Fig. 4 Puccinia purpurea.

on Sorghum vulgare 4 X; spores 403 X.

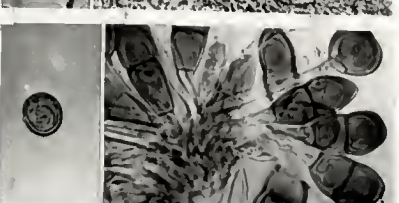
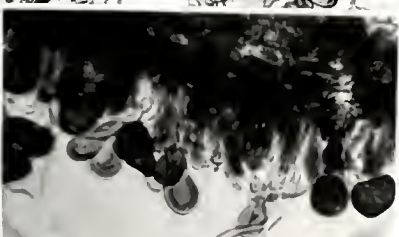
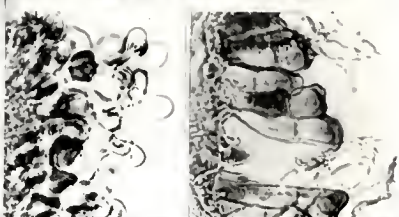
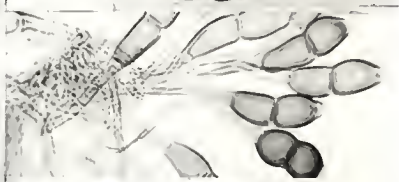
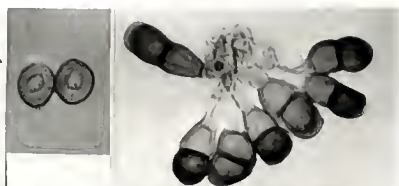
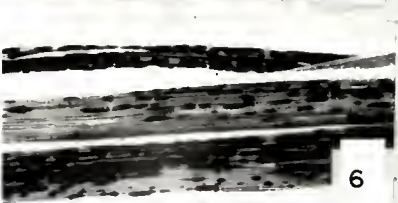
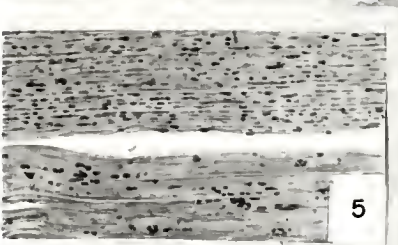
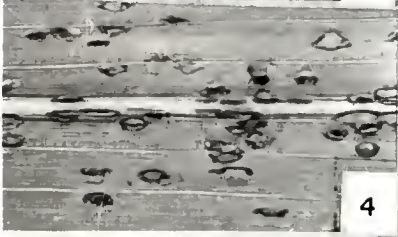
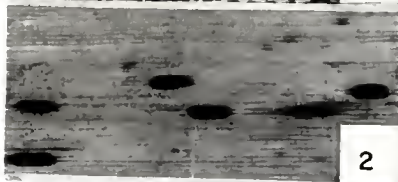
Fig. 5 Puccinia recondita.

on Triticum aestivum 4 X; spores 403 X.

Fig. 6 Puccinia redfieldiae.

on Redfieldia flexulosa 4 X; spores 403 X.

## PLATE XI





Alternate host unknown.

This fungus was first described from Kansas by Tracy, so its existence in Kansas cannot be doubted. There are no specimens in the K.S.U. Mycological Herbarium and has probably not been collected because of the relatively rare host (Redfieldia). The host specimens in the K.S.U. Herbarium (Redfieldia flexulosa) were examined and a collection by Gates 1929 (16168) was found to be infected with P. redfieldiae. A grass Collection from Finney County found was also to have several pustules of this rust.

SPECIMENS EXAMINED:

on Redfieldia flexulosa (Thurb.) Vasey: Morton Co.:  
grass on Flood Plain of Cimarron River, K-27, Gates (16168)  
and Haard (59), Aug. 28, 1929, II, III.

25. Puccinia schedonnardi Kellerm. and Sw., Jour. Myc. 4:95.  
1888. (Plate XII, Fig. 1)

Syn: Puccinia muhlenbergiae A and H Bull. Lab. Nat. Hist.  
Iowa 5:317. 1902.

Puccinia tosta Arth. Bull. Torr. Bot. Club. 29:229.  
1902.

Uredia VI, urediospores cinnamon, globoid or broadly ellipsoid 18-24 x 24-29, pores 4, side wall 2-3 u; telia naked; teliospores chestnut, broadly ellipsoid or oblong 16-25 x 27-42, side wall 1.5-2 u, apical wall 3-7 u, pedicel 130 u; host in tribes Agrostidae, Chloridae, Festuceae.

Alternate host in Malvaceae. Reported in Kansas on  
Callirhoe Malvastrum and Hibiscus.



## SPECIMENS EXAMINED:

on Muhlenbergia asperifolia (Nees and Man) Paradi:  
Webster Kansas, Bartholomew, as Puccinia tosta, Sept. 1905,  
 II, III.

on Muhlenbergia glomerata (Willd.) Trin.: Rooks Co.:  
 Both specimens misidentified for Puccinia dochmia, Stockton,  
Bartholomew, Sept. 1892, II, III; Stockton, Bartholomew, Sept.  
 1892, II, III.

on Muhlenbergia mexicana (L.) Trin.: Riley Co.: Sand  
 Dunes, Manhattan, White, as Puccinia muhlenbergiae, Dec. 31,  
 1921, III (also duplicate specimen). Rooks Co.: Stockton,  
Bartholomew (N. Am. Uredinales 49), as P. muhlenbergiae, Oct.  
 14, 1910, III.

on Muhlenbergia racemosa (Michx.) B.S.P.: Phillips Co.:  
Bartholomew, (Uredineae Exsiccate et Icones 50 e) as P.  
muhlenbergiae, March 7, 1895, II, III. Riley Co.: Ravine,  
 N of K.S.C. campus, Manhattan, Rogerson, Sept. 22, 1951, III;  
 along Wildcat Creek W of Manhattan, Rogerson, Oct. 15, 1954,  
 II, III. Rooks Co.: Stockton, Bartholomew (N. Am. Uredinales  
 2490), Oct. 10, 1910 249 III; Stockton, Bartholomew, (Fungi  
 Columb. 2670), as P. muhlenbergiae, July 20, 1908, II;  
 Stockton, Bartholomew, (Fungi Columb. 2065), as P. muhlenbergiae,  
 Sept. 12, 1904, III; Rockport, Bartholomew (Uredineae Exsiccate  
 et Icones 50c), as P. muhlenbergia, Oct. 3, 1894.

on Muhlenbergia schreberi Gmel.: Pottawatomie Co.:

Louisville, Bartholomew (N. Am. Uredinales, 2362), as P. muhlenbergiae on Muhlenbergia diffusae, Sept. 25, 1906, II  
Rooks Co.: Stockton, Bartholomew (Sydow Uredineen 1727),  
 as P. muhlenbergiae on Muhlenbergia diffusae, Sept. 13, 1902,  
 II, also duplicate specimen, (Fungi Columb. 1768).

on Schedonardius paniculatus (Nutt.) Trel.: Butler  
Co.: 5 mi W of Latham, Rogerson, Sept. 27, 1957, II, III.  
Pottawatomio Co.: N edge of Fostoria, Rogerson, Oct. 18,  
 1957, II, III. Riley Co.: Manhattan, Kellerman and Swingle  
 (1268), examined by J. F. Hennen, March 30, 1954, Type on  
Schedonardius texanus, March 18, 1888, II, III; Manhattan,  
Thompson (152), on S. texanus, Aug. 1, 1892, II, III. Rooks  
Co.: Stockton, Bartholomew (Sydow Uredineen 2384), Oct. 28,  
 1901; Stockton, Bartholomew, (N. Am. Uredinales 365), July  
 30, 1910, III; Stockton, (Bartholomew, Fungi Columb.  
 3263), July 28, 1910, II; Bartholomew (Uredineae Exsiccate  
 Et Icones 57a), Dec. 17, 1895, III.

26. Puccinia sessilis Schneid. ex Schroet., Abh. Schles. Ges  
 48:19. 1870. (Plate XII, Fig. 3).

Uredia VI; urediospores yellow-cinnamon, ellipsoid 18-26  
 x 19-28, side wall 1.5-2, pores 8. Telia covered; teliospores  
 oblong or oblong clavate, often angular, 19-26 x 35-55 u, side  
 wall 1.5-2 u, apical wall 3-7 u, pedicel 130 u. Host in tribe  
 Phalarideae.

Alternate host in Liliaceae. Reported in Kansas on Allium and Smilicina.

SPECIMENS EXAMINED:

on Phalaris caroliniana Walt: Cherokee Co.: Rogerson (R. 3764), June 3, 1955, II, III.

27. Puccinia seymouriana Arth.\*, Bot. Gaz. 34:11. 1902.  
(Plate XII, Fig. 2).

Uredia V; urediospores hyaline broadly ellipsoid or obovoid 16-27 x 29-44 u, side wall 2-3 u, spore apex 9-26 u, pores 2-3. Telia naked; teliospores chestnut, oblong or cylindric 15-22 x 38-60 u, side wall 1.5-2 u, apical wall 5-8 u, pedicel 150 u. Host in tribe Chloridace.

Alternate hosts in Apocynaceae and Asclepidaceae.  
Reported in Kansas on Cephalanthus and Apocynum.

SPECIMENS EXAMINED:

on Spartina pectinata Link.: Ottawa Co.: State Park, Rogerson, Nov. 1, 1957, III; 6 mi S of Ada, Nov. 1, 1957, III.

28. Puccinia sorghi Schw. Trans. Am. Phil. Soc. II 4:295. 1832.

Syn: Puccinia maydis Berenger, Atti. Soc. Ital. 6:475 hyponym 1845. Not Uredo maydis.

Uredia V; urediospores cinnamon, ellipsoid or globoid

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\* See discussion under P. spargonioides.

23-29 x 26-32 u, side wall 1.5-2, pores 3-4. Telia naked; teliospores chestnut; oblong or ellipsoid, 16-22 x 30-45 u, apical wall 5-7 u, pedicel 80 u. Host in tribe Maydeae.

Alternate host in Oxalidaceae. Reported in Kansas on Oxalis.

#### SPECIMENS EXAMINED:

on Zea mays L.: Allen Co.: E of Gas City, Rogerson and Pady, June 11, 1956, II. Butler Co.: Hitchcock, July, 1892, III. Cherokee Co.: Experimental Field, Columbus, Rogerson and Hansing, June 22, 1954, II. Douglas Co.: Northeast of Lawrence, Rogerson, June 19, 1957, II. Leavenworth Co.: Federal Prison Reservation, Rogerson and C. H. Looney, July, 1951, II. Marshall Co.: Marysville, Rogerson, July 31, 1956, II. Pottawatomie Co.: Westmoreland, Rogerson and H. Goertz, Sept. 13, 1950, II and III. Riley Co.: E of Manhattan, Rogerson and Williams, Sept. 14, 1957, II; Manhattan, Rogerson and Tatum, Sept. 1953, II, III; Rogerson and Johnston, Oct. 14, 1957, III; Manhattan, Thompson, July 20, 1891; Manhattan, Carleton, April 18, 1892, II, III; Manhattan, Kellerman and Swingle (2332), Oct. 10, 1888; Manhattan, Thompson (83), as Puccinia maydis, July 20, 1891, II; Manhattan, Thompson (89), as P. maydis, Aug. 10, 1891, II, III. Books Co.: Stockton, Bartholomew, N. Am. Uredinales (368), Sept. 22, 1910, II; Rockport, Bartholomew (Kansas Fungi 1082), Sept. 9, 1893, II; Stockton, Bartholomew (Fungi Columb. 2777), Sept. 2, 1908, II.

28. Puccinia sparganioides Ell. and Barth., Erythea 4:2. 1896.

Syn: Puccinia peridermiospora (Ell. and Tr.) Arth., Science II. 10:565. 1899.

Puccinia fraxinata Arth., Bot. Gaz. 34:6. 1902.

Uredia V; urediospores hyaline obovoid or ellipsoid 18-30 x 29-45 u, side wall 1.5-3 u apex 7-10 u, pores 4. Telia naked; teliospores chestnut, oblong or ellipsoid, 14-23 x 38-62 u, side wall 1.5-2 u, apical wall 5-7 u, pedicel 100 u. Host in tribe Chloridae.

Alternate host in Oleaceae. Reported in Kansas on Fraxinus.

Considerable confusion arose in separating the species, Puccinia sparganioides Ell. and Barth., Puccinia seymouriana Arth., and Puccinia distichidis Ell. and Ev. In my opinion these fungi are a morphologically closely related group. The only reliable method in determining which species is present is to use both the uredial and telial stages. For future determinations a specific name should be put on a fungus in this group only if both the uredial and telial stages are present.

There were several collections in the KSU herbarium identified as Puccinia phragmites Korn. on Spartina cynosuroides (L.) Roth. This species does not occur on Spartina and was an obvious mistake in identification and should be Puccinia sparganioides. A single collection by Bartholomew (N. Am. Fungi, 3475) has been identified as Puccinia sparganioides

on Carex stricta. Bartholomew (1899) corrected his identification of this collection and restricted the host range of this species to Spartina and Phragmites. The type for this species was described on Carex sparganioides. This means that the name Puccinia sparganioides does not apply to Spartina and Phragmites, due to the fact that the species which occur on Carex is distinct from the species which occur on Phragmites and Spartina. This constitutes a problem beyond the scope of this paper and will be dealt with in future work.

#### SPECIMENS EXAMINED:

on Spartina cynosuroides (L.) Roth. (This host is probably Spartina pectinata (Link.) Jahrb. Jewell Co.: Mankato, J. T. Pearson and White, as P. peridermiospora Ell. and Tracy, July 28, 1922, III. Johnson Co.: Carleton, as Puccinia phragmites, Aug. 25, 1892, III. McPherson Co.: Hitchcock, as P. phragmites Korn, July 29, 1892, III. Pottawatomie Co.: Louisville, Bartholomew (1216), as P. phragmites, Oct. 16, 1893, III. Riley Co.: Agronomy Farm, Manhattan, Johnston and White as P. peridermiospora, Dec. 10, 1921, III; Manhattan, Thompson as P. phragmites, Dec. 25, 1890, III; Manhattan, Thompson as P. phragmites, June 27, 1892, II, III. Rooks Co.: Bartholomew, (Fungi Columb., 1576) as P. peridermiospora (changed from P. phragmites and P. sparganioides, Sept. 15, 1897, III; Stockton, Bartholomew (Sydow Uredineen 2423), as P. peridermiospora, Sept. 20, 1904; Stockton, Bartholomew (Sydow Uredineen. 1982), as P. peridermiospora,

Sept. 20, 1904, III; Bartholomew (Uredineae Exsiccate et Icones, 541) as P. fraxinata, Oct. 30, 1897, III; Palco, Bartholomew (Uredineae Exsiccate et Icones, 54h) as P. fraxinata, Aug. 24, 1895, II, III; Stockton, Bartholomew (Fungi Columb. 2055) as P. fraxinata, Sept. 20, 1904, III. Sedgwick Co.: Wichita, Carleton as P. phragmites, March 10, 1888, III.

on Spartina pectinata: Atchison Co.: 4 mi S of Muscotah, growing in a drier portion of an Artesian Marsh, W. H. Hosr (4861) as P. peridermiospora, Sept. 23, 1954, III. Osage Co.: 6 mi N of Lyndon on U.S. 75, Kramer and Duffield (RTH 62), Aug. 14, 1958 B, III; 9 mi N of Lyndon on U.S. 56, Kramer and Duffield (RTH 63), Aug. 14, 1958, II, III. Rooks Co.: Stockton, Bartholomew (N. Am. Uredinales 543), host Spartinia michauxana Hitch. as P. fraxinata, Sept. 20, 1904, III.

29. Puccinia sporoboli Arth., Bull. Iowa Agr. Coll. Dep. Bot. 1884:159. 1884. (Plate XII, Fig. 6).

Uredia V; urediospores cinnamon, flattened globoid, 21-31 x 23-30 u, side wall 1-2 u, pores 4-6 (basal). Telia naked; teliospores chestnut, oblong or ellipsoid 16-26 x 28-50 u, side wall 1.5 u, apical wall 5-10 u, pedicel 50 u. Host in tribe Agrostidae.

Alternate host in Liliaceae, proven only in culture.

#### SPECIMENS EXAMINED:

on Sporobolus asper (Michx.) Kuntz: Franklin Co.: Ottawa,



Grace Wecker, Dec. 23, 1893, III. Riley Co.: Manhattan,  
Hitchcock, Dec. 1., 1892, III. Rooks Co.: Bartholomew  
 (769), Rockport, Nov. 4, 1892, III. Rush Co.: 16 mi S of  
 LaCrosse, on U.S. 183, Kramer (2634) and Duffield, Sept.  
 4, 1958, II, III.

on Sporobolus vaciniflorus (Torr.) Wood: Commanche  
Co.: 5 mi E of Coldwater on U.S. 160, Kramer (2624) and  
Duffield, Sept. 5, 1958, II, III; 5 mi E of Coldwater on U.S.  
 160--wasteland, Kramer (2622) and Duffield, Sept. 5, 1958.  
Riley Co.: Manhattan, R. Kenny and Melchers, Oct. 15, 1915,  
 III.

29. Puccinia striiformis West. Bull. Soc. Roy. Acad. Belge.  
 21:(2)235. p. 64. 1854. (Plate VII, Fig. ).

Syn: Puccinia glumarum Eriks. et Henn. K. Landthr.--  
 Akad. Handl. Tidskr. 33:169. 1894. Zeitschr.  
 f. Pflanzenkr. 4:197. 1894.

Uredia in long lines on golden-yellow streaks VI;  
 urediospores hyaline, globoid or ellipsoid 19-26 x 19-30 u,  
 wall 1-2 u, pores 10-15 u. Telia covered with paraphyses,  
 sori in fine lines; teliospores chestnut, oblong-clavate,  
 13-24 x 32-36 u, side wall 1 u, apical wall 3-6 u, pedicel  
 115 u. Host in tribes Festuceae, Hordeae.

Alternate host unknown. The range of this species on  
 the wild grasses has never been explored in Kansas.

SPECIMENS EXAMINED:

on Triticum aestivum L.: Cheyenne Co.: S of Wheeler,



Rogerson, 1957, II; S edge of Wheeler, Rogerson, June 21, 1957, II. Cloud Co.: 3 mi W of Ames, Johnston, May 30, 1957, II. Dickinson Co.: 2 mi E of Elmo, Rogerson, Pady and Johnston, May 29, 1957, II; N of Abilene, Rogerson, Pady and Johnston, June 3, 1957, II. Ellsworth Co.: E edge of Wilson, Rogerson, Pady and Johnston, June 3, 1957, II. Geary Co.: W of Junction City, Rogerson, Pady and Johnston, June 3, 1957, II. Lincoln Co.: 1 mi W of Lincoln, Rogerson, Pady and Johnston, June 3, 1957, II; 3 mi E of Deverly, Rogerson, Pady and Johnston on van Kiowa, June 3, 1957, II. Logan Co.: W of Russell Springs, Rogerson, June 20, 1957, II. Marshall Co.: S of Waterville, Rogerson, Pady and Johnston, June 3, 1957, II. Ottawa Co.: W of Bennington, Rogerson and Pady, June 12, 1957, II; 6 mi E of Bennington, Rogerson, Pady and Johnston, June 3, 1957, II; W of Bennington, Rogerson, Pady and Johnston, June 3, 1957, II. Pottawatomie Co.:  $\frac{1}{2}$  mile W of Belvidere, Rogerson and Pady, May 31, 1957, II. Riley Co.: Ashland Bottoms, Johnston and Rogerson, May 31, 1957, II; Zeandale, Rogerson and Pady, June 1, 1957, II. Russell Co.: 12 miles S of Lucas, Rogerson, Pady and Johnston, June 3, 1957, II; 1 mi E of Lucas, Rogerson, Pady and Johnston, June 3, 1957, II. Saline Co.: 2 mi W of Bavaria, Rogerson, Pady and Johnston, June 3, 1957, II; Jct. Hw. 4 and 81, Rogerson, Pady and Johnston, June 29, 1957, II. Shawnee Co.: 4 mi W of Rossville, Rogerson, Pady and Johnston, June 1, 1957, II. Wabaunsee Co.:  $\frac{1}{2}$  mi W of Wabaunsee, Rogerson and Pady, June 1,

Plate XII

Fig. 1 Puccinia schedonnardi.

on Muhlenbergia racemosa 4 X; spores 403 X.

Fig. 2 Puccinia seymouriana.

on Spartina pectinata 4 X; spores 403 X.

Fig. 3 Puccinia sessilis.

on Phlaris carolina 4 X; spores 403 X.

Fig. 4 Puccinia sorghi.

on Zea mays 4 X; spores 403 X.

Fig. 5 Puccinia sparsanioides.

on Spartina pectinata 4 X; spores 403 X.

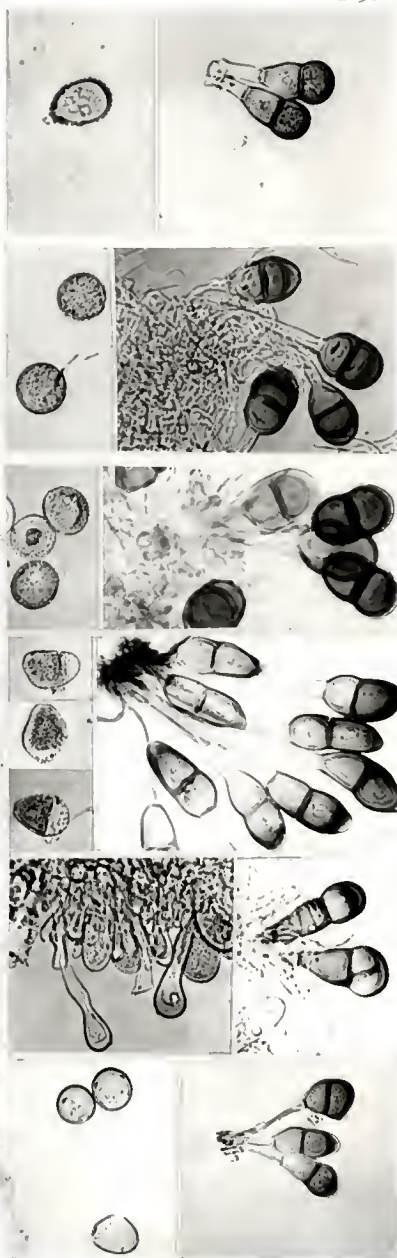
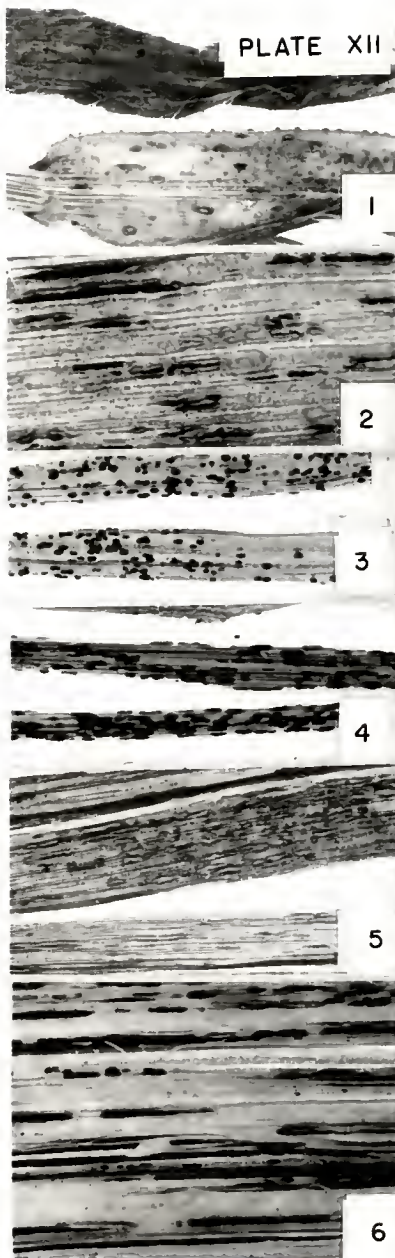
Fig. 6 Puccinia sporoboli.

on Sporobolus cryptandrus 4 X; spores 403 X..

Fig. 7 Puccinia striiformis.

on Triticum aestivum 4 X; spores 403 X.

## PLATE XII



1957, II; N of Maple Hill, Rocerson and Pady, June 1, 1957,  
II.

30. Puccinia substriata Ell. and Barth. Erythea 5:47. 1897.  
(Plate XIII, Fig. 1).

Uredia V; urediospores cinnamon, broadly ellipsoid 23-30 x 28-36 u, side wall 1.5-2 u, pores 4. Telia naked; teliospores chestnut oblong or ellipsoid 19-26 x 33-50 u, side wall 1.5-2 u, apical wall 3-7 u, pedicel 30 u. Host in tribe Paniceae.

Alternate host unknown.

This species very closely resembles Puccinia emaculata Schw. and Puccinia panici. Care must be taken in separating these fungi.

#### SPECIMENS EXAMINED:

on Paspalum setaceum: Rooks Co.: Stockton, Bartholomew (N. Am. Uredinales, 2167, Type Collection), Aug. 20, 1896, II, Bartholomew (Uredineae Exsiccate Et Icones 42a), Sept. 5, 1896, II, III; Bartholomew (N. Am. Fungi 3577), Sept. 1896, II, III.

31. Puccinia tripsaci D and H Holw. Bot. Gaz. 24:27. 1897.  
(Plate XIII, Fig. 2).

Syn: Puccinia pattersoniae Syd., Monog. Ured. 1:820.  
1904.

Puccinia ceanothi A. and F., N. Am. Flora. 7:279.  
1920.

Uredia V; urediospores golden brown to cinnamon, globoid or broadly ellipsoid 26-31 x 26-33 u, side wall 1.5-2, 3

pores. Telia naked; teliospores chestnut, ellipsoid or obovoid 19-27 x 30-40 u, side wall 2-3 u, apical wall 5-8 u, pedicel 90 u. Host in tribes Andropogoneae and Maydeae.

Alternate host on Rhamnaceae. Reported in Kansas on Ceanothus.

#### SPECIMENS EXAMINED:

on Andropogon gerardi Vitm.: Jefferson Co.: NE of Williams-town, Rogerson, July 19, 1957, II, III. Riley Co.: 5 mi E of Jct. K-13 and U.S. 40; Kramer (2590) and Duffield, Sept. 19, 1958, II, III; Agronomy Farm, Kansas State College, Kramer (2589) and Duffield, Aug. 15, 1955, II, III; Ashland Agronomy Farm, Rogerson, Aug. 15, 1955, II, III. Rooks Co.: Stockton, Bartholomew (N. Am. Uredinales 122) as Puccinia ceanothi, issued as Puccinia andropogonis, Oct. 6, 1910, III.

on Tripsacum dactyloides L.: Riley Co.: Manhattan, Carleton (Sydow Uredineen 2072) as Puccinia pattersoniae, Apr. 6, 1893, III; Manhattan, Carleton (Fungi Columb. 2265) as P. pattersoniae, Sept. 6, 1893, III; Manhattan, May Varney (Sydow Uredineen) as Puccinia pattersoniae (part of TYPE), Dec. 5, 1889, III; Soil Conservation Nursery, Anderson and Rogerson, Oct. 1, 1952, II, III; Manhattan, Kellerman and Swingle (2857), March 23, 1889, III; Ashland Agronomy Farm Johnston and Kramer 2586, Oct. 22, 1958, III.

32. Puccinia vexans Farl. Proc. Am. Acad. Sci. 18:82. 1883. (Plate XIII, Fig. 3).

Syn: Uromyces brandegei, Peck, Bot. Gaz. 4:127. 1879.

Uredia VI; urediospores yellow-cinnamon globose or ellipsoid, 28-29 x 26-32 u, side wall 2-3 u, 8 pores; amphispores predominant. Telia naked, teliospores chestnut broadly ellipsoid 23-29 x 32-36 u, side wall 2.5-3 u, apical wall 6-12 u, pedicel 110 u. Host in tribe Chloridaceae.

Alternate host in Fouquieriaceae. Not reported in Kansas.

SPECIMENS EXAMINED:

on Bouteloua curtipendula (Michx.) Torr.: Butler Co.: 5 mi N of Latham, Rogerson, Sept. 27, 1957, III. Ellis Co.: Hays Exp. Sta., Rogerson, June 10, 1954, II, III. Franklin Co.: Ottawa, Grace Meeker (13) and Carleton (987) on Bouteloua racemosa Lag., Dec. 18, 1893, III. Geary Co.: 2.5 mi S of Jct. of U.S. 40 and K-13 on K-13, Kramer (2599) and Duffield, Aug. 14, 1958, II, III. Logan Co.: Russell Springs, U.S. 75, Haard (64) and Kramer, Oct. 9, 1961, II, III. Osage Co.: 6 mi N of Lyndon on U.S. 75, Kramer and Duffield, Aug. 14, 1958 (B) II, III. Ottawa Co.: Pottawatomie Co.: St. George, Carleton 631, Bouteloua racemosa Lag, Nov. 16, 1893, III. Riley Co.: Manhattan, Rogerson, Sept. 27, 1953, II; Manhattan, Thompson (157) as Uromyces brandegei as Bouteloua racemosa, Sept. 6, 1892, III; Rt. 13, 2 mi S of Manhattan, Rogerson, July 8, 1957, II. Rooks Co.: Rockport, Bartholomew (1067), on Bouteloua racemosa, Aug. 26, III; Stockton, Bartholomew (N. Am. Uredinales 773), on Antheropogon curtipendulus Fourn. Sept. 19, 1911, III; Stockton, Bartholomew, (Fungi Columb.



3575), on Antheropogon curtibendulus, Sept. 19, 1911, III;  
 Stockton, Bartholomew (N. Am. Uredinales 72), Aug. 20, 1910,  
 III. Wabaunsee Co.: 12 mi E Jct. K-13 and U.S. 40, Kramer  
 (2591) and Duffield, Sept. 19, 1958, III.

33. Puccinia vilfae Arth. et Holw. Bull. Iowa Lab. Nat. Hist.  
4:388. 1898. (Plate XIII, Fig. 4).

Syn: Puccinia sydowiana Diet., Hedw. 36:299. 1897.  
Nat. Zopf. 1879.

Puccinia verbenicola Arth., Bot. Gaz. 35:16.  
 1903.

Uredia V; urediospores hyaline. obovoid or ellipsoid,  
 20-26 x 26-33 u, side wall 1.5-2 u, apex 5-10 u, pores 6-8.  
 Telia naked, teliospores chestnut, ellipsoid or oblong, 18-26  
 x 38-55 u, apical wall 5-9 u, side wall 1.5-2.5 u, pedicel  
 115 u. Host in tribe Agrostidae.

Alternate host in Verbeniaceae. Reported in Kansas on  
Verbena.

#### SPECIMENS EXAMINED:

on Sporobolus asper (Michx.) Kunth.: Butler Co.:  
 5 mi W of Latham, Rogerson, Sept. 27, 1957, III. Coffee Co.:  
 7 mi W of Burlington, Kramer (2637) and Duffield, Sept. 26,  
 1958, II, III. Cowley Co.: at Butler Co. line on U.S. 77  
 prairie pasture, Kramer (2649) and Duffield, Aug. 14, 1958,  
 III. Lyon Co.: 2 mi S of Admire on K-99, Kramer (2642)  
 and Duffield, Sept. 26, 1958, II, III. Osage Co.: 5 mi  
 W of Osage City, on U.S. 56, Kramer (2639) and Duffield,  
 Aug. 14, 1958, II, III. Pottawatomie Co.: Louisville,



Bartholomew (Fungi Columb. 3865) as P. verbenicola on Sporobolus drummondi (Trin.) Vasey, Oct. 19, 1911, III; Louisville, Bartholomew (N. Am. Uredinales 671); as P. verbenicola on Sporobolus drummondi, Oct. 19, 1911, III. Riley Co.: Manhattan, Thompson and Bartholomew (Kansas Fungi Fascicle I 51) as P. verbenicola (1892), III; 5 mi E of Jct. K-13 and U.S. 40, Kramer (2640) and Duffield, Sept. 19, 1958, II, III; Manhattan, Johnston and White as P. sydowiana Diet. Jan 3, 1922, III. Rooks Co.: Rockport, Bartholomew (Sydow Uredineen 1032, part of Type) as P. sydowiana, Apr. 3, 1895; Bartholomew (N. Am. Fungi 3570) as P. sydowiana, Jan. 1897, III; Rockport, Bartholomew, (Sydow Uredineen 1280) mixture with Uromyces sporoboli, Aug. 10, 1898, II, III. Shawnee Co.: 10 mi W of Topeka on U.S. 40, Kramer (2643) and Duffield, Sept. 19, 1958, III. Wabaunsee Co.: 12 mi E Jct. K-13 and U.S. 40, Kramer (2638) and Duffield, Sept. 19, 1958, II, III.

on Sporobolus airoides (Torr.) Torr.: Rooks Co.: Bartholomew (N. Am. Uredinales 476), as P. verbenicola on Sporobolus longifolius (Torr.) Wood, June 30, 1910, II. Smith Co.: Smith Center, Bartholomew (Fungi Columb. 1869), as P. verbenicola on Sporobolus longifolius, Aug. 11, 1903, II.

on Sporobolus heterolepis A. Gray: Riley Co.: 5 mi E Jct. K-13 and U.S. 40, Kramer (2632) and Duffield, Sept. 19, 1958, II, III.

34. Puccinia virgata Ell. and Ev. Proc. Acad. Phil. 1893:154.  
1893. (Plate XIII, Fig. 5).

Syn: Puccinia clavisporea Ell. and Barth., Erythea 4:79.  
1896.

Uredia I; urediospores chestnut, clavate or capitate,  
20-27 x 31-40 u, paraphyses clavate or capitate, side wall  
2-3 u, pores 3-6. Telia naked; teliospores chestnut, oblong  
or oblong-clavate 18-26 x 45-60, side wall 1.5-2 u, apical  
wall 5-10 u, pedicel 20 u. Host in tribe Andropogoniae.

Alternate host unknown.

#### SPECIMENS EXAMINED:

on Sorghastrum nuttans (L.) Nash: Lyons Co.: Emporia,  
Bartholomew, (Fungi Columb. 2971) on Chrysopogonis avenaceus  
(Benth.) Sept. 13, 1908, II. Riley Co.: Soil Conservation  
Nursery, Rogerson, Sept. 29, 1950, II, III; Agronomy Farm,  
Rogerson and Pickett, Sept. 3, 1954, II; K.S.C. Agronomy  
Farm, Johnston and Rogerson, Sept. 23, 1953, II, III;  
Agronomy Farm, Rogerson, Oct. 23, 1950, II. Rooks Co.:  
Bartholomew (1911) as P. clavisporea Ell. and Barth. on  
Andropogon nuttans, Sept. 23, 1895, II, III; Bartholomew  
(Sydow Uredineen 1066) as P. clavisporea; on Andropogon nuttans,  
Oct. 2, 1896, II, III; Bartholomew (Ellis and Everhart N.  
Am. Fungi 3476) as P. clavisporea; on Andropogon nuttans;  
Bartholomew (Economic Fungi 535) Sept. 23, 1895, II, III;  
Stockton, Bartholomew (Fungi Columb. 2677) on Chrysopogonis  
avenaceus, Sept. 17, 1908, III. Stockton, Bartholomew,  
(N. Am. Uredinales 73) on Chrysopogon avenaceus (Mx.) Bentr,

March 23, 1897, III; Bartholomew (Arthur and Holway: Uredineae Exsiccatae et Icones 37a), on Chrysopogon avenaceus, Sept. 12, 1895.

35. Puccinia windsoriae Schw. Trans. Amer. Phil. Soc. II. 4:295. 1832. (Plate XIII, Fig. 6).

Syn: Puccinia triodiae E and B Erythea 4:3. 1896.

Uredia VIII, urediospores cinnamon, globose or obovoid, 20-26 x 24-31 u, side wall 1.5-2 u, pores 5-6. Telia naked; teliospores chestnut ellipsoid or oblong, 16-23 x 29-43 u, side wall 2-2.5 u, apical wall 4-7 u, pedicel 70 u. Host in tribe Festuceae.

Alternate host in Rutaceae. Reported in Kansas on Ptelea.

Cummins (1956) listed Puccinia triodiae as a synonym of Puccinia windsoriae under the host Tridens. This is correct but the host range of Puccinia windsoriae must be extended to Triplasis, due to the fact that Puccinia triodiae was first described on Triodia purpurea which is a synonym for Triplasis purpurea. Specimens listed on Muhlenbergia were not P. windsoriae but P. schedonnardi.

#### SPECIMENS EXAMINED:

on Tridens flava (L.) Hitchc.: Anderson Co.: SE of Garnett, Rogerson, as Triodia flava (L.) Hitchc. Oct. 13, 1955. Cherokee Co.: Shermashorn City Park, Gleva City Park, Rogerson and Kramer (1423);

Plate XIII

Fig. 1 Puccinia substriata.

on Paspalum setaceum 4 X; spores 403 X.

Fig. 2 Puccinia tripsaci.

on Tripsacum dactyloides 4 X; spores 403 X.

Fig. 3 Puccinia vexans.

on Bouteloua curtipendula 4 X; spores 403 X.

Fig. 4 Puccinia vilfae.

on Sporobolus asper 4 X; spores 403 X.

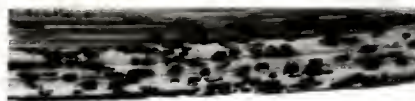
Fig. 5 Puccinia virgata.

on Sorghastrum nuttans 4 X; spores 403 X.

Fig. 6 Puccinia windsorise.

on Triodia flavus 4 X; spores 403 X.

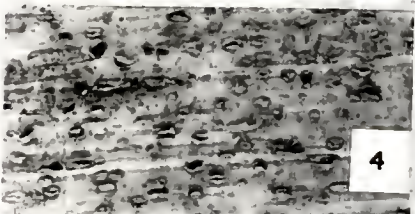
## PLATE XIII



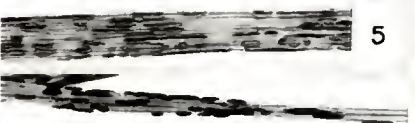
2



3



4



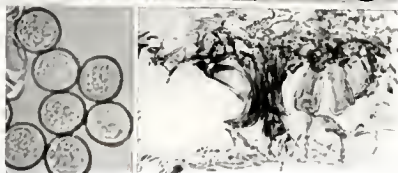
5



6



7



on Triodens flavus (L.) Hitchc. Oct. 1, 1955, III.  
Douglas Co.: University of Kansas, grown to maturity in  
 Greenhouse, Rogerson, host as Triodia flava, July 19, 1957,  
 II. Leavenworth Co.: 4 miles NE of Tonganoxie, McGregor  
 (9727) and Kramer (824) on Triodia flava, Oct. 2, 1954, III.  
Riley Co.: Manhattan, White, Dec. 12, 1921, III; Soil  
 Conservation Nursery, Ashland, Anderson and Rogerson, on  
Triodia flava; along Wildcat Creek W of Manhattan, Rogerson,  
 on Triodia flava, Sept. 10, 1954, III. Rooks Co.: Stockton,  
Bartholomew (N. Am. Uredinales 174), on Sieglingia seslerioides  
 Scrib. Nov. 29, 1910 III; Stockton, Bartholomew (N. Am.  
 Uredinales 173), on S. seslerioides, Aug. 26, 1910, II.  
Wabaunsee Co.: 12 mi E of Jct. K-13 and U.S. 40, Kramer and  
Duffield and Haard (66), Sept. 19, 1958.

on Tridens stricta (Nutt.) Benth.: Crawford Co.: 4 mi ,  
 north of Pittsburg on U.S. 69, Kramer and Duffield (Haard 65),  
 July 29, 1958, II.

on Triplasis purpurea (Walt.) Chap.: Rooks Co.: Stockton,  
Bartholomew (N. Am. Uredinales 372) as P. triodiae, Bartholomew  
 (N. Am. Fungi 3474) as P. triodiae on Triodia purpurea;  
Bartholomew as P. triodiae; on Triodia purpurea, 1897, II,  
 III.

#### UROMYCES Link

Ogs. II, 28. 1816.

Type species: Uromyces appendiculatus Link.



A heteroecious fungus typically completing it's life cycle on two hosts. The uredial and telial stages will only be discussed in this treatment since this is the only stage that occurs on grasses. Uromyces and Puccinia are closely related and Uromyces can only be separated by the presence of a single celled teliospore.

Uredia covered or naked; paraphyses present or not; urediospores single celled, hyaline, yellow to cinnamon, echinulate verrucose or smooth, pores one to ten, scattered or equatorial; usually born on pedicels but may be single. Telia covered or erumpant to naked; paraphyses present or not; teliospores single celled, smooth cinnamon to chestnut, pedicels present.

1. Uromyces aristidae Ell. and Ev., Jour. Myc. 3:56. 1887.

Uredia VII, urediospores golden brown to cinnamon, globoid or ellipsoid, 19-26 x 26-33 u. Telia naked; teliospores chestnut, smooth becoming tessellately cracked, globoid or broadly obovoid 18-26 x 23-30 u, side wall 2-3 u, apical wall 4-7 u, pedicel 100 u. Host in tribe Agrostidae.

Alternate host unknown.

#### SPECIMENS EXAMINED:

The specimens examined were found to be mistakenly identified for Uromyces peckianus Farl. The differences between these two species are very plain, the principle one being that in U. aristidae the urediospores are strongly



echinulate and in U. peckianus the uredia are verrucose. This species is probably not present in Kansas but is included here until further collecting can be done.

2. Uromyces graminicola Burr. Bot. Gaz. 9:188. 1884.  
(Plate XIV, Fig. 3).

Uredia VI, urediospores, golden brown to cinnamon, broadly ellipsoid, 17-23 x 20-26 u, side wall 2-2.5 u, pores 3-4. Telia naked; teliospores chestnut often angular, ellipsoid or oblong 13-19 x 21-32, side wall 1.5-2 u, apical wall 3-9 u, pedicel 80 u. Host in tribe Paniceae.

Alternate host on Euphorbiaceae. Not reported for Kansas.

#### SPECIMENS EXAMINED:

on Panicum virgatum L.: Butler Co.: 5 mi W of Latham, Rogerson, Sept. 27, 1957, III. Coffee Co.: 7 mi W of Burlington, Kramer (2633) and Duffield, Sept. 26, 1958, III; Rt. 75 3 mi S of Burlington, Haard (68) and Kramer, Oct. 14, 1961, II, III. Cowley Co.: at Butler Co. line on U.S. 77, Kramer (2616) and Duffield, Sept. 5, 1961, II, III. Dickinson Co.: S of Herrington, Rogerson, Oct. 18, 1955, III. Franklin Co.: Ottawa, Meeker and Carleton (500), Dec. 3, 1893, III; Ottawa, Meeker and Carleton (Uredineae Americanae 1) Dec., 1893, III. Geary Co.: 2.5 mi S of Jct. K-13 and U.S. 40, Kramer (2636) and Duffield, Aug. 14, 1958, II, III. Logan Co.: 6 mi E of Council Grove on Rt. 56, Haard (69), Oct. 29, 1961, III. Lyon Co.: 2 mi S of Admire

on K-99, Kramer (2621) and Duffield, Sept. 26, 1958, III;  
 5 mi S of Olpe, Rogerson, July 26, 1957, II, III; 8 mi NE  
 of Emporia on K-99, Kramer (2620) and Duffield, July 30, 1958,  
 II, III. Pottawatomie Co.: Kramer, July 2, 1959, III.  
Reno Co.: Hutchinson, Kellerman, Oct. 28, 1889, III. Riley  
Co.: Manhattan, Thompson 119, March 19, 1892, III; Manhattan,  
Thompson (16), Dec. 18, 1890, III; 5 mi E of Jct. K-13 and U.S.  
 40, Kramer (2619) and Duffield, Sept. 19, 1958, III; 4 mi  
 NW of Manhattan, Kramer, Duffield and Haard (70), Sept. 24,  
 1958, III; Soil Conservation Nursery, Ashland, Rogerson and  
Anderson, Oct. 1, 1951, III; field west of Manhattan Country  
Club; Rogerson, Aug. 9, 1953, II, III; Agronomy Farm, Rogerson  
 and Pickett, Sept. 3, 1954, III; Agronomy Farm, Rogerson and  
Pickett, Sept. 3, 1954, II, III; Ashland Agronomy Farm,  
Rogerson and Pickett, Oct. 1955, III; Agronomy Farm, Rogerson  
 and Pickett, Sept. 3, 1954, II, III. Rooks Co.: Rockport,  
Bartholomew (Uredineae Exsiccate et Icones 19c), Aug. 10,  
 1894, II; Stockton, Bartholomew, (N. Am. Uredinales 190),  
 Oct. 9, 1910, III; Rockport, Bartholomew (Kansas Fungi 732),  
 Oct. 4, 1892, III; Rockport, Bartholomew (Uredineae Exsiccate  
et Icones 19a), Apr. 6, 1894 (II, III). Shawnee Co.: 10  
 mi W of Topeka, Kramer (2617) and Duffield, Sept. 19, 1958,  
 III.

3. Uromyces hordeinus (Arth.) Barth., Hand Book N. Am.  
Ured. Ed. 1 63:1928. (Plate XIV, Fig. 4).

Syn: Uromyces hordei Tracy, Jour. Myc. 7:281. 1893.  
Not Nielson, 1875.

Uromyces hordeinus (Arth.) Arth. Man. Rusts in U.S.  
and Canada. 177:1934.

Uredia VI; urediospores yellow to golden brown, broadly ellipsoid, 16-24 x 22-27 u, sidewall 1.5-2u, pores 8-10.

Telia covered with paraphyses, especially on sheaths, telia chestnut, angular, 18-25 x 23-34 u sidewall 1.5-2.5 u, apical wall 3-6 u, pedicel 20 u. Host in tribes Hordeae, Festuceae.

Alternate host in Liliaceae. Reported in Kansas on Nothoscordium.

#### SPECIMENS EXAMINED:

on Festuca octaflora Walt: Riley Co.: Prairie W of Manhattan, Rogerson, May 27, 1957, III.

on Hordeum brachyantherum Neuski: Rooks Co.: Bartholomew (Sydow Uredineen 1804) as U. hordei on Hordeum nodosum L., July 3, 1903; Bartholomew (Sydow Uredineen 1803) as U. hordei, on Hordeum nodosum, June 15, 1903, II.

on Hordeum pusillum Nutt.: Ellsworth Co.: E of Wilson, Rogerson, June 3, 1957, II, III. Greely Co.: S Tribune, Rogerson, June 19, 1957, III. Lincoln Co.: W Shady Bend, Rogerson and Padx, June 3, 1957, II, III. Linn Co.: S Cadmos, Rogerson, June 10, 1957, II, III. Norton Co.: W Norton, Rogerson, June 21, 1957, II, III. Phillips Co.: W Phillipsburg, Rogerson, June 4, 1957, II, III. Rawlins Co.: E of McDonald, Rogerson, June 21, 1957, II, III. Reno Co.: W of Sylvia,

Rogerson, June 17, 1957. Republic Co.: 10 mi S Belleville,  
Rogerson, June 26, 1957, III. Riley Co.: Prairie W Manhattan,  
Rogerson, May 26, 1957, III; Warner Park W Manhattan, Rogerson,  
 June 2, 1957, II, III; N end of county, Johnston and Rogerson,  
 June 10, 1957, II, III. Rooks Co.: Stockton, Bartholomew,  
 (N. Am. Uredinales 387), as U. hordei Tracy; Stockton, Bartholomew  
 (Fungi Columb. 1895), as U. hordei July 4, 1903, III; Stockton,  
Bartholomew, (N. Am. Uredinales 2491), as U. hordei, June 13,  
 1817, III. Russell Co.: 6 mi S. Lucas, Rogerson, June 3, 1957,  
 II, III. Scott Co.: W Scott City, Rogerson, June 19, 1957.  
Sherman Co.: N Goodland, Rogerson, June 20, 1957, III.

4. Uromyces peckianus Parl., Proc. Amer. Acad. 18:78. 1883.  
 (Plate XIV, Fig. 2).

Syn: Nigredo seditiosa Arth., N. Am. Flora. 7:255.  
 1912.

Uredia VIII; urediospores yellow to golden brown, globoid  
 or broadly ellipsoid, 16-23 x 18-25 u, sidewall 2.5-3 u, pores  
 5-6. Telia naked, teliospores golden brown to chestnut globoid  
 to ellipsoid 16-23 x 24-55 u, sidewall 1.5-3 u, apical wall  
 4-10 u, pedicel 100 u. Host in tribes Festuceae and Agrostidae.

Alternate host in Chenopodiaceae. Reported in Kansas on  
Plantago.

This species was previously listed as Uromyces aristidae  
 Ell. and Ev. This was a mistake in identification and all  
 collections of Uromyces ariditidae that were examined are U.  
peckianus.

## SPECIMENS EXAMINED:

on Aristida basvianae Vasey: Riley Co.: Manhattan, Norton and Thompson (188) as Uromyces aristidae, III; Manhattan, Thompson (Uredineae Americanae 26) as U. aristidae, Dec. 1893, III.

on Aristida fenderliana Stued: Coffee Co.: Rt. 75, 3 mi S of Burlington, Haard (71), Oct. 14, 1961, III.

on Aristida longiseta Stued: Jackson Co.: 3 mi E Vermillion River on Rt. 16, Haard (74) and Kramer, Sept. 9, 1961, III. Riley Co.: 5 mi E Junct. K-13 and U.S. 40, Kramer Duffield (Haard 73), Sept. 19, 1958, III.

on Aristida oligantha Michx: Lyon Co.: Brome and Lespidez pasture, Kramer and Haard (72) 1958, III. Trego Co.: Wakeeny, Bartholomew, (Fungi Columb. 2390) as U. aristidae, Sept. 15, 1906, III.

5. Uromyces sporoboli Ell. and Ev., Proc. Acad. Sci. Philza. 1893:155. 1893. (Plate XIV, Fig. 1).

Uredia V; urediospores golden brown to cinnamon, broadly or narrowly ellipsoid, 23-30 x 29-40 u, sidewall 1.5-2 u, pores 4-5. Telia naked; teliospores chestnut, obovate or globoid, 19-28 x 29-40 u, sidewall 1.5-2 u, apical wall 5-8 u, pedicel 110 u. Host in tribe Agrostidae.

Alternate host in Liliaceae. Reported in Kansas on Allium.

Plate XIV

Fig. 1 Uromyces sporoboli.

on Sporobolus asper 4 X; spores 403 X.

Fig. 2 Uromyces peckianus.

on Distichidis spicata 4 X; spores 403 X.

Fig. 3 Uromyces graminicola.

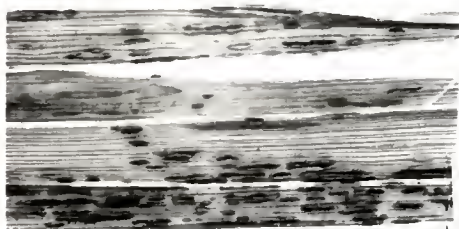
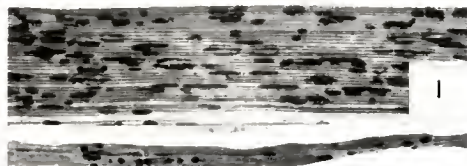
on Panicum virgatum 4 X; spores 403 X.

Fig. 4 Uromyces hordeinus.

on Hordeum puscillium 4 X; spores 403 X.



## PLATE XIV





on Sporobolus asper (Michx.) Kunth.: Butler Co.:  
 5 mi W Latham, Rogerson (mixed with Puccinia vilifae), Sept.  
 27, 1957, III. Rooks Co.: Rockport, Bartholomew (Kansas  
 Fungi 733), Sept. 24, 1892; Rockport, Bartholomew (N. Am.  
 Fungi 2884), Nov. 4, 1892, III.

on Sporobolus longiflorus (Torr.) Wood.: Rooks Co.:  
 Stockton, Bartholomew, (N. Am. Uredinales 3000), July 24,  
 1923, II; Stockton, Bartholomew (Fungi Columb. 3396), June  
 28, 1910, II, III; Stockton, Bartholomew (N. Am. Uredinales  
 300), Oct. 9, 1911, III.

on Sporobolus neglectus Nash: Rooks Co.: Stockton,  
Bartholomew, (N. Am. Uredinales 1498), Sept. 28, 1915, III;  
Bartholomew (Fungi Columb. 1599), Oct. 15, 1901, III.

#### CONCLUSIONS

The records of rusts and smuts from Kansas and specimens at the KSU Mycological Herbarium have been found to be quite complete. Only five species are not represented in the herbarium which have been reported in the literature as occurring in Kansas. The accuracy of early identifications is quite good but there were several misinterpretations and some expected errors. These misinterpretations were due largely to a misunderstanding of the host-parasite relationships.

Verifications of the reported species not represented in the KSU herbarium have not yet been made. These are

Urocystis occulta (Wallr.) Rabenh., Ustilago hypodytes (Schlecht) Fries, Sorosporium everhartii Ell. and Gall., Sorosporium ellisii Wint. and Puccinia hordei Pckl. Two other species that had been reported for Kansas were present in the herbarium but these collections were misidentified. The packets labeled Puccinia poarum Bot. was actually Puccinia poae-nemorialis Oth., and the packets labeled Uromyces aristidae Ell. and Ev. was actually Uromyces peckianus Farl., therefore these two species are probably not present in Kansas but will be left on the present list as unsubstantiated.

Puccinia redfieldiae Tracy has been reported in the literature (Bartholomew 1927) but was not represented in the mycological herbarium at KSU. However in examining specimens of the host, Redfieldia flexulosa (Thurb.) Vasey in the KSU vascular plant herbarium the author found a collection of this grass by F. C. Gates to be heavily infested with this rust. It is interesting to note that this species of rust was first described from a herbarium sheet, in the same manor in which this specimen of P. redfieldiae was found.

Puccinia distichidis Ell. and Ev. and Puccinia sporoboli Arth. were represented in the KSU Herbarium as specimens, but have not been reported in the literature. These two species shall now formally be listed as new records for the state.

There are many species of rusts which are extremely difficult to differentiate. In future collections only excellent quality material of these species should be placed

in the herbarium in order to prevent possible future confusion. I will not elaborate here on these fungi which are morphologically similar because this has been done best in discussions of the individual species. A few of these fungi that are difficult to differentiate are Sphacelotheca sorghi and Sphacelotheca cruenta on Sorghum halepense; Puccinia distichidis, P. sparganioides and seymouriana on Spartina pectinata; and Puccinia emaculata and P. panici on Panicum virgatum.

A number of rust and smut species have not been collected in Kansas for 75 years, even though in some cases the type was described from this area. These species are obviously quite rare and thus a special effort should be made to look for them in Kansas on their specific hosts. For example Puccinia abnorminis P. Hen on Echinochoa crus-galli (L.) B. and Br. has not been reported in Kansas since 1908. There are many species which are in this situation today. In the summer of 1962 Kramer and Haard found Ustilago utriculosa (non-graminaceous) in relative abundance on Polygonum pennsylvanicum in Northeastern Kansas. This was the first collection of this fungus in Kansas since 1905. It has probably been here all this time but due to its inconspicuous nature was continually overlooked.

Many additional species have been well collected on one or two hosts when their actual host range is quite broad. For example, Puccinia striiformis West. was collected quite extensively in Kansas on Triticum aestivum L. in 1958, but

not a single collection was made on one of its other 21 host genera which occur in Kansas. Other examples include P. graminis Pers. known only on 10 of 47 possible host genera; P. coronata Cda. known on 4 of 33 possible host genera and P. recondita Rob. ex Desm. on 8 of 34 possible host genera that occur in Kansas. This is only a partial list but will serve to illustrate this point. If these fungi do not actually occur in Kansas on these hosts then it seems likely that there may be physiological races of these species which we as yet do not understand. However, there is a good chance that these fungi do occur on these hosts but (due to a lack of understanding of the mechanisms of distribution and parasitism of these rusts and smuts) we have not as yet collected them.

#### SUMMARY

The following table summarizes the amount of rusts and smuts in Kansas, their reported hosts and possible hosts.

Genera	Number of species known from Kansas	Number of host genera known to occur in Kansas	
<hr/>			
<u>Smuts</u>			
Sorosporium	5**	5	5
Sphacelotheca	6	4	5
Tilletia	5	4	9
Tolysporella	1	1	1
Urocystis	2*	6	15
Ustilago	<u>18*</u>	18	48
Total	37		

Rusts

Puccinia	38**	42	70
Uromyces	$\frac{5*}{80}$ 43	5	7

\* these figures include 1 unsubstantiated species

\*\* these figures include 2 unsubstantiated species

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\* these figures include 1 unsubstantiated species

\*\* these figures include 2 unsubstantiated species

A host genus index and illustrated key to the rust fungi is presented for the first time in this treatment. Additional copies have been prepared and sent to various mycologists for comments and criticisms. This key and the others in this treatment have been broadened to take in species that could occur in Kansas, thus making this manuscript desirable for reference in much of the great plains.

An extensive field survey of rusts and smuts in Kansas was made and specimens identified were entered in the herbarium at KSU.